Division of Measurement Standards
Field Reference Manual
Revision Index

2005	
Revised Pages	
Revision Index D-INTRO-1 to D-INTRO-2 D1-1 to D1-2 D2-5 to D2-6 D2-9 to D2-12 D2-14-A to D2-14-B D2-21 to D2-22 D2-25 to D2-26	D2-27 to D-32-B D2-43 to D2-54 D3-5 to D3-14 D3-39 to D3-42 D5-27 to D5-34 D-DEF-1 toD-DEF-18 APNDX-A-1 to APNDX-A-2 P-1 to P-2-2
2004	
Revised Pages	
D0-1 to D0-2 D1-1 to D1-6 D2-1 to D2-26 D3-5 to D3-14 D3-17 to D3-20 D3-25 to D3-28 D3-31 to D3-34	D3-39 to D3-42 D3-45 to D3-50 D5-19 to D-24-B D5-25 to D5-25-C D-DEF-1 to D-DEF-4 D-DEF-9 to D-DEF-14
2003	
Revised Pages	
D2-8A to D2-12 D2-27 to D2-32B D2-47 to D2-50 D3-7 to D3-14 D3-17 to D-20 D3-31 to D3-34	D3-37 to D3-40 D3-45 to D3-50 D3-57 to D3-58 D5-23 to D5-24 D5-29 to D5-32 D-DEF-1 to D-DEF-16

THIS INFORMATION IS AVAILABLE ON THE DIVISION WEBSITE AT
www.cdfa.ca.gov/dms under "Forms and Publications".

If you need assistance, please contact the Division of Measurement Services at (916) 229-3000 or by e-mail dms@cdfa.ca.gov.

Introduction

A. Source. - The specifications, tolerances, and other technical requirements published herein comprise, in their latest form, all of the current codes as adopted by the National Conference on Weights and Measures.[1] The National Conference is sponsored by the National Institute of Standards and Technology (NIST), which provides the NCWM secretariat and publishes NCWM documents. NIST also develops technical publications for use by weights and measures agencies; these publications may subsequently be endorsed or adopted by the NCWM.

The Conference Committee on Specifications and Tolerances,[2] acting at the request of the Conference or upon its own initiative, with the technical assistance of the National Institute of Standards and Technology, annually prepares proposed revisions, amendments, or additions to the material previously adopted by the Conference (see paragraph C). Such revisions, amendments, or additions are then presented to the Conference as a whole, where they are discussed by weights and measures officials and representatives of interested manufacturers and industries. Eventually the proposals of the Committee are voted upon only by the weights and measures officials.

All of the specifications, tolerances, and other technical requirements given herein are recommended by the National Conference on Weights and Measures for official promulgation in and use by the States in exercising their control of commercial weighing and measuring apparatus. A similar recommendation is made with respect to the local jurisdictions within a State in the absence of the promulgation of specifications, tolerances, and other technical requirements by a State agency.

B. Purpose. - The purpose of these technical requirements is to eliminate from use, weights and measures and weighing and measuring devices that give readings that are false, that are of such construction that they are faulty (that is, that are not reasonably permanent in their adjustment or will not repeat their indications correctly), or that facilitate the perpetration of fraud, without prejudice to apparatus that conforms as closely as practicable to the official standards.

[1] When sitting as a voting body, the National Conference on Weights and Measures (NCWM) is made up of State and local weights and measures officials from all parts of the United States. The NCWM normally meets annually.

[2] Communications to this committee may be addressed as follows: Executive Secretary, National Conference on Weights and Measures, National Institute of Standards and Technology, Gaithersburg, MD 20899.

C. Amendments. - The Committee on Specifications and Tolerances of the NCWM provides a mechanism for consideration of amendments or additions to the specifications, tolerances, and other technical requirements. The following procedures are based on NCWM Publication 3, "Policy, Interpretations, and Guidelines" (see Section 1 - NCWM Management, Subsection 1 - Organization and Committees) that were amended at the 83rd NCWM Annual Meeting in 1998.

D. Submission of Agenda Items - Preamble. - The Constitution of the NCWM requires that its officers and Committees observe the principles of due process for the protection of the rights and interests of affected parties. Specifically, it requires that Committees and Officers: (a) give reasonable advance notice of contemplated studies, issues to be considered for action, and tentative or definite recommendations for conference vote; and (b) provide that all interested parties have an opportunity to be heard.

E. Submission Process. - Anyone introducing an issue to the Committee shall use the regional weights and measures associations to initially consider its merits. Using the regional associations ensures discussion and evaluation of issues at the grass-roots level by involving the regional members in the development, evaluation, and justification of proposals. The regions include the Central, Northeastern, Southern, and Western Weights and Measures Associations. For information on the regional associations contact NCWM, at the address listed below or, by telephone at 301-975-4004, or on the Internet at http://www.nist.gov/owm.

F. Procedures

The Committee will consider issues according to the following procedures:

a. All issues to be considered by the Committee for action at the upcoming Interim Meeting must be submitted in writing to the Committee by November 1. Although use of NCWM Form 15 is not required, it is recommended for use in submitting proposals to the NCWM. Proposals shall be sent to the Committee at:

NIST Office of Weights and Measures
Building 820, Room 223
Gaithersburg, Maryland 20899
Attention: NCWM Specifications and Tolerances Committee

b. A copy of the proposal must be sent to the NCWM's Executive Secretary at the same address.

G. Criteria for Inclusion in the Committee's Agenda.

a. Any issue approved by at least one regional association and received by the November 1 deadline will be automatically placed on the Committee's Interim Meeting Agenda.

b. Issues that have not been approved by a regional association, but which are received by November 1, will be evaluated by the Committee using the criteria in Section H, Exceptions to Policy and Section I, Committee Agenda.

c. Any proposal received after the November 1 deadline, but prior to the Interim Meeting, will be evaluated by the Committee according to Section H, Exceptions to Policy and Section I, Committee Agenda. Only those issues determined to be a national "Priority" will be included on its agenda.

d. Proposals must be in writing and must include:

(1) a concise statement of the issue or problem outlining the purpose and national need for its consideration. When possible, an electronic copy of the background material and proposed amendment(s) should be submitted in a PC compatible word processing document format (e.g., Corel WordPerfect or Microsoft Word) on electronic media or by electronic mail using the same format;
(Amended 2004)

(2) background material including test data, analysis of test data, or other appropriately researched and documented material from which the Committee will be able to make a judgment for either a firm recommendation or consideration of the need for further study;

(3) proposed solutions to problems stated in specific language in amendment form to Conference documents; and

(4) practical, realistic, and specific recommendations for both regulations and test methods to provide for proper enforcement, if a proposal involves a new area of weights and measures activity.

When proposals are to modify or add requirements to existing publications, such as Handbook 44, the proposal should:

(i) Identify the pertinent portion, section, and paragraph of the existing publication that would be changed (e.g., Sec. 1.10. General Code, paragraph G-A.1. Commercial and Law-Enforcement Equipment).

(ii) Provide evidence of consistency with other NCWM publications such as with other specific device code sections.

(iii) Provide evidence of consistency with Federal laws and regulations (e.g., USDA).

(iv) Relay the positions of businesses, industries, or trade associations affected by the proposal including supporting and opposing points of view.

H. Exceptions to Policy for Submission of Issues to a Committee Agenda; Submission of "Priority" Issues.

The Committee will use the following criteria to evaluate issues that have not been approved by a regional association, but has been received by the November 1 deadline. If an issue is received after the November 1 deadline, it will be included on an agenda, if the Committee determines that it is a national "Priority."

Criteria for Inclusion in the Committee's ggenda when no Regional Association has approved the Issues.

(1) Issues must have significant legal impact on weights and measures laws and/or regulations involving:

(a) court cases/attorney general opinions; or

(b) pre-emption by Federal statute or regulation; or

(c) conflict with international standards; or

(d) relationship to laws or regulations of an urgent nature which could affect health and safety.

(2) The Committee may contact parties that are potentially affected by an issue (e.g., trade associations, industry, and consumer groups) for comments. The Committee may consider these comments and any other information in determining if the issue should be included on its agenda.

(3) When the Committee determines that it should consider an issue as a "Priority" (using the criteria in (1)), the issue will be handled in the following manner:

(a) A "priority" issue received prior to the Interim Meeting may be added to the Interim Meeting agenda by majority vote of the Committee.

(b) A "priority" issue received after the Interim Meeting may be added to the Committee's Annual Meeting agenda as: (i) a discussion issue by majority vote of the Committee, or (ii) as a voting item by majority vote of the Committee and the NCWM Board of Directors.

Sec. 1.10. General Code

G-A. Application

G-A.1. Commercial and Law-Enforcement Equipment. - These specifications, tolerances, and other technical requirements apply as follows:

(a) To commercial weighing and measuring equipment; that is, to weights and measures and weighing and measuring devices commercially used or employed in establishing the size, quantity, extent, area, or measurement of quantities, things, produce, or articles for distribution or consumption, purchased, offered, or submitted for sale, hire, or award, or in computing any basic charge or payment for services rendered on the basis of weight or measure.

(b) To any accessory attached to or used in connection with a commercial weighing or measuring device when such accessory is so designed that its operation affects the accuracy of the device.

(c) To weighing and measuring equipment in official use for the enforcement of law or for the collection of statistical information by government agencies.

(These requirements should be used as a guide by the weights and measures official when, upon request, courtesy examinations of noncommercial equipment are made.)

G-A.2. Code Application. - This General Code shall apply to all classes of devices as covered in the specific codes. The specific code requirements supersede General Code requirements in all cases of conflict.
(Amended 1972)

G-A.3. Special and Unclassified Equipment. - Insofar as they are clearly appropriate, the requirements and provisions of the General Code and of specific codes apply to equipment failing, by reason of special design or otherwise, to fall clearly within one of the particular equipment classes for which separate codes have been established. With respect to such equipment, code requirements and provisions shall be applied with due regard to the design, intended purpose, and conditions of use of the equipment.

G-A.4. Metric Equipment. - Employment of the weights and measures of the metric system is lawful throughout the United States. These specifications, tolerances, and other requirements shall not be understood or construed as in any way prohibiting the manufacture, sale, or use of equipment designed to give results in terms of metric units. The specific provisions of these requirements and the principles upon which the requirements are based shall be applied to metric equipment insofar as appropriate and practicable. The tolerances on metric equipment, when not specified herein, shall be equivalent to those specified for similar equipment constructed or graduated in the inch-pound system.

G-A.5. Retroactive Requirements. – "Retroactive" requirements are enforceable with respect to all equipment. Retroactive requirements are printed herein in upright Roman type.

G-A.6. Nonretroactive Requirements. – "Nonretroactive" requirements are enforceable after the effective date for:

(a) devices manufactured within a State after the effective date;

(b) both new and used devices brought into a State after the effective date; and

(c) devices used in noncommercial applications which are placed into commercial use after the effective date.

Nonretroactive requirements are not enforceable with respect to devices that are in commercial service in the State as of the effective date or to new equipment in the stock of a manufacturer or a dealer in the State as of the effective date. *[Nonretroactive requirements are printed in italic type.]*
(Amended 1989)

G-A.7. Effective Enforcement Dates of Code Requirements. - Unless otherwise specified, each new or amended code requirement shall not be subject to enforcement prior to January 1 of the year following the adoption by the National Conference on Weights and Measures and publication by the National Institute of Standards and Technology.

G-S. Specifications

G-S.1. Identification. - All equipment, except weights and separate parts necessary to the measurement process but not having any metrological effect, shall be clearly and permanently marked for the purposes of identification with the following information:

(a) the name, initials, or trademark of the manufacturer or distributor;

(b) a model designation that positively identifies the pattern or design of the device;

1. The model designation shall be prefaced by the term "Model," "Type," or "Pattern." These terms may be followed by the term "Number" or an abbreviation of that word. The abbreviation for the word "Number" shall, as a minimum, begin with the letter "N" (e.g., No or No.) The abbreviation for the word "Model" shall be "Mod" or "Mod." Prefix lettering may be initial capitals, all capitals or all lower case. [Nonretroactive as of January 1, 2003]

(Added 2000) (Amended 2001 and 2004)

(c) a nonrepetitive serial number, except for equipment with no moving or electronic component parts and not built-for-purpose, software-based devices;
[Nonretroactive as of January 1, 1968]
(Amended 2003 and 2004)

1. *The serial number shall be prefaced by words and abbreviation, or a symbol, that clearly identifies the number as the required serial number;*
[Nonretroactive as of January 1, 1986]

2. *Abbreviations for the word "Serial" shall, as a minimum, begin with the letter "S," and abbreviations for the word "Number" shall, as a minimum, begin with the letter "N" (e.g., S/N, SN, Ser. No, and S No).*
[Nonretroactive as of January 1, 2001]

(d) the current software version designation for not built-for-purpose, software-based devices.
[N*onretroactive as of January 1, 2004]*

(e) an NTEP Certificate of Conformance (CC) number or a corresponding CC Addendum Number for devices that have a CC. The CC number or a corresponding CC Addendum Number shall be prefaced by the terms "NTEP CC," "CC," or "Approval." These terms may be followed by the term "Number" or an abbreviation of that word. The abbreviation for the word "Number" shall, as a minimum, begin with the letter "N" (e.g., No or No.).
[Nonretroactive as of January 1, 2003]
(Added 2001)

The required information shall be so located that it is readily observable without the necessity of the disassembly of a part requiring the use of any means separate from the device.
(Amended 1985, 1991, 1999, 2000, 2003, and 2004)

G-S.1.1. Location of Marking Information for Not Built-For-Purpose, Software-Based Devices. *– For not built-for-purpose, software-based devices, the following shall apply:*

(a) the manufacturer or distributor and the model designation shall be continuously displayed or marked on the device (see note below), or

(b) the Certificate of Conformance (CC) Number shall be continuously displayed or marked on the device (see note below), or

(c) all required information in G-S.1. Identification. (a), (b), (d), and (h) shall be continuously displayed. Alternatively, a clearly identified "view only" System Identification, G-S.1. Identification, or Weights and Measures Identification shall be accessible through the "Help" menu. Required information includes that information necessary to identify that the software in the device is the same type that was evaluated.
(Amended 2004)

***Note**: Clear instructions for accessing the remaining required G-S.1. information shall be listed on the CC. Required information includes that information necessary to identify that the software in the device is the same type that was evaluated.*
[Nonretroactive as of January 1, 2004]
(Added 2003)

G-S.1.2. Remanufactured Devices and Remanufactured Main Elements.

[NOT ADOPTED]

G-S.2. Facilitation of Fraud. - All equipment and all mechanisms and devices attached thereto or used in connection therewith shall be so constructed, assembled, and installed for use such that they do not facilitate the perpetration of fraud.

G-S.3. Permanence. - All equipment shall be of such materials, design, and construction as to make it probable that, under normal service conditions:

(a) accuracy will be maintained,

(b) operating parts will continue to function as intended, and

(c) adjustments will remain reasonably permanent.

Undue stresses, deflections, or distortions of parts shall not occur to the extent that accuracy or permanence is detrimentally affected.

G-S.4. Interchange or Reversal of Parts. - Parts of a device that may readily be interchanged or reversed in the course of field assembly or of normal usage shall be:

(a) so constructed that their interchange or reversal will not affect the performance of the device, or

(b) so marked as to show their proper positions.

(c) the total price, and

(d) the product class or, in a system equipped with price look-up capability, the product name or code number.

S.1.9. Prepackaing Scales.

S.1.9.1. Value of the Scale Division. - On a pre-packaging scale, the value of the intervals representing weight values shall be uniform throughout the entire reading face. The recorded weight values shall be identical with those on the indicator.

S.1.9.2. Label Printer. - A prepackaging scale or a device that produces a printed ticket to be used as the label for a package shall print all values digitally and of such size, style of type, and color as to be clear and conspicuous on the label.

S.1.10. Adjustable Components. - An adjustable component such as a pendulum, spring, or potentiometer shall be held securely in adjustment and, except for a zero-load balance mechanism, shall be located within the housing of the element.
(Added 1986)

S.1.11. Provision for Sealing.

(a) Except on Class I scales, provision shall be made for applying a security seal in a manner that requires the security seal to be broken before an adjustment can be made to any component affecting the performance of an electronic device.
[Nonretroactive as of January 1, 1979.]

(b) Except on Class I scales, a device shall be designed with provision(s) for applying a security seal that must be broken, or for using other approved means of providing security (e.g., data change audit trail available at the time of inspection), before any change that detrimentally affects the metrological integrity of the device can be made to any electronic mechanism.
[Nonretroactive as of January 1, 1990.]

(c) Except on Class I scales, audit trails shall use the format set forth in Table S.1.11.
[Nonretroactive as of January 1, 1995.]

A device may be fitted with an automatic or a semi-automatic calibration mechanism. This mechanism shall be incorporated inside the device. After sealing, neither the mechanism nor the calibration process shall facilitate fraud.
(Amended 1989, 1991, 1993)

S.1.12. Manual Weight Entries. - *A device when being used for direct sale shall accept an entry of a manual gross or net weight value only when the scale gross or net* weight indecation is at zero. Recorded manual weight entries, except those on labels generated for packages of standard weights, shall identify the weight value as a manual weight entry by one of the following terms: "Manual Weight," "Manual Wt," or "MAN WT." The use*

Table S.1.11. Categories of Device and Methods of Sealing

Categories of Device	*Method of Sealing*
Category 1: No remote configuration capability.	*Seal by physical seal or two event counters: one for calibration parameters and one for configuration parameters.*
Category 2: Remote configuration capability, but access is controlled by physical hardware. *Device shall clearly indicate that it is in the remote configuration mode and record such message if capable of printing in this mode.*	*The hardware enabling access for remote communication must be at the device and sealed using a physical seal or two event counters: one for calibration parameters and one for configuration parameters.*
Category 3: Remote configuration capability access may be unlimited or controlled through a software switch (e.g., password).	*An event logger is required in the device; it must include an event counter (000 to 999), the parameter ID, the date and time of the change, and the new value of the parameter. A printed copy of the information must be available through the device or through another on-site device. The event logger shall have a capacity to retain records equal to ten times the number of sealable parameters in the device, but not more than 1000 records are required.* ***(Note: Does not require 1000 changes to be stored for each parameter.)***

[Nonretroactive as of January 1, 1995.]
(Table added 1993)

of a symbol to identify multiple manual weight entries on a single document is permitted, provided that the symbol is defined on the same page on which the manual weight entries appear and the definition of the symbol is automatically printed by the recording element as part of the document.
[Nonretroactive as of January 1, 1993]
*[*Nonretroactive as of January 1, 2005]*
(Added 1992) (Amended 2004)

S.1.13. Vehicle On-Board Weighing Systems: Vehicle in Motion. - When the vehicle is in motion, a vehicle on-board weighing system shall either:

(a) be accurate; or

(b) inhibit the weighing operation.
(Added 1993)

S.2. Design of Balance, Tare, Level, Damping, and Arresting Mechanisms.

S.2.1. Zero-Load Adjustment.

S.2.1.1. General. - A scale shall be equipped with means by which the zero-load balance may be adjusted. Any loose material used for this purpose shall be enclosed so that it cannot shift in position and alter the balance condition of the scale.

S.2.1.2. Scales Used in Direct Sales. - A manual zero-setting mechanism (except on a digital scale with an analog zero-adjustment mechanism with a range of not greater than one scale division) shall be operable or accessible only by a tool outside of and entirely separate from this mechanism, or it shall be enclosed in a cabinet. Except on Class I or II scales, a balance ball shall either meet this requirement or not itself be rotatable.

A semiautomatic zero-setting mechanism shall be operable or accessible only by a tool outside of and separate from this mechanism or it shall be enclosed in a cabinet, or it shall be operable only when the indication is stable within:

(a) plus or minus 3 scale divisions for scales of more than 2 000 kg (5 000 lb) capacity in service prior to January 1, 1981, and for all axle-load, railway track, and vehicle scales; or

(b) plus or minus 1 scale division for all other scales.

S.2.1.3. Scales Equipped With an Automatic Zero-Setting Mechanism. - *Under normal operating conditions the maximum load that can be "rezeroed," when either placed on or removed from the platform all at once, shall be:*

(a) for bench, counter, and livestock scales: 0.6 scale division;

(b) for vehicle, axle-load, and railway track scales: 3.0 scale divisions; and

(c) for all other scales: 1.0 scale division.
[Nonretroactive and enforceable as of January 1, 1981.]

S.2.1.3.1. Automatic Zero-Setting Mechanism on Class III L Devices – *Class III L devices equipped with automatic zero setting mechanisms shall be designed with a sealable means to allow the automatic zero setting to be disabled during the inspection and test of the device.*
[Nonretroactive as of January 1, 2001]
(Added 1999)

S.2.1.4. Monorail Scales. - On a static monorail scale equipped with digital indications, means shall be provided for setting the zero-load balance to within 0.02 percent of scale capacity. On a dynamic monorail weighing system, means shall be provided to automatically maintain these conditions.
(Amended 1999)

S.2.1.5. Initial Zero-Setting Mechanism.

(a) Scales of accuracy Classes I, II, and III may be equipped with an initial zero-setting device.

(b) An initial zero-setting mechanism shall not zero a load in excess of 20 percent of the maximum capacity of the scale unless tests show that the scale meets all applicable tolerances for any amount of initial load compensated by this device within the specified range.
(Added 1990)

S.2.1.6. Combined Zero-Tare ("O/T") Key. - Scales not intended to be used in direct sales applications may be equipped with a combined zero and tare function key, provided that the device is clearly marked as to how the key functions. The device must also be clearly marked on or adjacent to the weight display with the statement "Not for Direct Sales."
(Added 1998)

S.2.2. Balance Indicator. - On a balance indicator consisting of two indicating edges, lines, or points, the ends of the indicators shall be sharply defined. When the scale is in balance, the ends shall be separated by not more than 1.0 mm (0.04 in).

Table 3
Parameters for Accuracy Classes

Class	*Value of the verification scale division (d or e[1])*	*Number of scale[4] divisions (n)*	
		Minimum	*Maximum*
SI Units			
I	*equal to or greater than 1 mg*	*50 000*	------
II	*1 to 50 mg, inclusive*	*100*	*100 000*
III[2, 5]	*equal to or greater than 100 mg*	*5000*	*100 000*
	0.1 to 2 g, inclusive	*100*	*10 000*
	equal to or greater than 5 g	*500*	*10 000*
III L[3]	*equal to or greater than 2 kg*	*2000*	*10 000*
IIII	*equal to or greater than 5 g*	*100*	*1 200*
INCH-POUND Units			
III[5]	*0.0002 lb to 0.005 lb, inclusive*	*100*	*10 000*
	0.005 oz to 0.125 oz, inclusive	*100*	*10 000*
	equal to or greater than 0.01 lb	*500*	*10 000*
	equal to or greater than 0.25 oz	*500*	*10 000*
III L[3]	*equal to or greater than 5 lb*	*2 000*	*10 000*
IIII	*greater than 0.01 lb*	*100*	*1 200*
	greater than 0.25 oz	*100*	*1 200*

[1] For Class I and II devices equipped with auxiliary reading means (i.e., a rider, a vernier, or a least significant decimal differentiated by size, shape, or color), the value of the verification scale division "e" is the value of the scale division immediately preceding the auxiliary means.

[2] A scale marked "For prescription weighing only" may have a verification scale division (e) not less than 0.01 g. (Added 1986) (Amended 2003)

[3] The value of a scale division for crane and hopper (other than grain hopper) scales shall be not less than 0.2 kg (0.5 lb). The minimum number of scale divisions shall be not less than 1000.

[4] On a multiple range or multi-interval scale the number of divisions for each range independently shall not exceed the maximum specified for the accuracy class. The number of scale divisions, n, for each weighing range is determined by dividing the scale capacity for each range by the verification scale division, e, for each range. On a scale system with multiple load receiving elements and multiple indications, each element considered shall not independently exceed the maximum specified for the accuracy class. If the system has a summing indicator, the n_{max} for the summed indication shall not exceed the maximum specified for the accuracy class.

[5] The minimum number of scale divisions for a Class III Hopper Scale used for weighing grain shall be 2000. (Added 2004)

[Nonretroactive as of January 1, 1986.]
(Amended 1986, 1987, 1997, 1998, 1999, 2000 and 2004)

Table S.6.3.a.
Marking Requirements

To Be Marked With	Weighing Equipment				
	Weighing, load-receiving, and indicating element in same housing or covered on the same CC[1]	Indicating element not permanently attached to weighing and load-receiving element or covered by a separate CC	Weighing and load-receiving element not permanently attached to indicating element or covered by a separate CC	Load cell with CC (11)	Other equipment or device (10)
Manufacturer's ID (1)	x	x	x	x	x
Model Designation and Prefix (1)	x	x	x	x	x
Serial Number and Prefix (2)	x	x	x	x	x (16)
Certificate of Conformance Number (CC) (23)	x	x	x	x	x (23)
Accuracy Class (17)	x	x (8)	x (19)	x	
Nominal Capacity (3)(18)(20)	x	x	x		
Value of Scale Division, "d" (3)	x	x			
Value of "e" (4)	x	x			
Temperature Limits (5)	x	x	x	x	
Concentrated Load Capacity (CLC) (12)(20)(22)		x	x (9)		
Special Application (13)	x	x	x		
Maximum Number of Scale Divisions (n_{max}) (6)		x (8)	x (19)	x	
Minimum Verification Scale Division (e_{min})			x (19)		
"S" or "M" (7)				x	
Direction of Loading (15)				x	
Minimum Dead Load				x	
Maximum Capacity				x	
Safe Load Limit				x	
Load Cell Verification Interval (v_{min}) (21)				x	
Section Capacity and Prefix (14)(20)(22)(24)		x	x		

Note: For applicable notes, see Table S.6.3.b.

[1] Weighing/load receiving elements and indicators which are in the same housing or which are permanently attached will generally appear on the same CC. If not in the same housing, elements shall be hard wired together or sealed with a physical seal or an electronic link. This requirement does not apply to peripheral equipment that has no input or effect on device calibrations or configurations.
(Added Footnote 1, 2001)

(Added 1990) (Amended 1992, 1999, 2000, 2001, 2002 and 2004)

Table S.6.3.b.

Notes For Table S.6.3.a.

1. Manufacturer's identification and model designation and *model designation prefix*.*
   **[Nonretroactive as of January 1, 2003.]*
   (See G-S.1.) *[Prefix lettering may be initial capitals, all capitals or all lower case.]*
   (Amended 2000)

2. *Serial number [Nonretroactive as of January 1, 1968] and prefix [Nonretroactive as of January 1, 1986].*
   (See G-S.1.)

3. The nominal capacity *and value of the scale division shall be shown together (e.g., 50 000 x 5 kg, 100 000 x 10 lb, 15 x 0.005 kg, or 30 x 0.01 lb) adjacent to the weight display when the nominal capacity and value of the scale division are not immediately apparent. Each scale division value or weight unit shall be marked on multiple range or multi-interval scales.*
   [Nonretroactive as of January 1, 1983.]

4. *Required only if different from "d."*
   [Nonretroactive as of January 1, 1986.]

5. *Required only on Class III, III L, and IIII devices if the temperature range on the NTEP CC is narrower then and within –10 °C to 40 °C (14 °F to 104 °F).*
   [Nonretroactive as of January 1, 1986.]

6. *This value may be stated on load cells in units of 1 000; e.g., n: 10 is 10 000 divisions.*
   [Nonretroactive as of January 1, 1988.]

7. *Denotes compliance for single or multiple load cell applications. It is acceptable to use a load cell with the "S" or Single Cell designation in multiple load cell applications as long as all other parameters meet applicable requirements. A load cell with the "M" or Multiple Cell designation can be used only in multiple load cell applications.*
   [Nonretroactive as of January 1, 1988.]
   (Amended 1999)

8. *An indicating element not permanently attached to a weighing element shall be clearly and permanently marked with the accuracy Class of I, II, III, III L, or IIII, as appropriate, and the maximum number of scale divisions, n_{max},, for which the indicator complies with the applicable requirement. Indicating elements that qualify for use in both Class III and III L applications may be marked III/III L and shall be marked with the maximum number of scale divisions for which the device complies with the applicable requirements for each accuracy class.*
   [Nonretroactive as of January 1, 1988.]

9. *For vehicle and axle-load scales only. The CLC shall be added to the load-receiving element of any such scale not previously marked at the time of modification.*
   [Nonretroactive as of January 1, 1989.]
   (Amended 2002)

10. Necessary to the weighing system but having no metrological effect, e.g., auxiliary remote display, keyboard, etc.

11. *The markings may be either on the load cell or in an accompanying document; except that, if an accompanying document is provided, the serial number shall appear both on the load cell and in the document. [Nonretroactive as of January 1, 1988.] The manufacturer's name or trademark, the model designation, and identifying symbol for the serial number shall also be marked both on the load cell and in any accompanying document.*
    [Nonretroactive as of January 1, 1991.]

12. Required on the indicating element *and the load-receiving element* of vehicle and axle-load scales. *Such marking shall be identified as "concentrated load capacity" or by the abbreviation "CLC".**
    *[*Nonretroactive as of January 1, 1989.]*
    (Amended 2002)

13. *A scale designed for a special application rather than general use shall be conspicuously marked with suitable words, visible to the operator and to the customer, restricting its use to that application, e.g., postal scale, prepack scale, weight classifier, etc.** When a scale is installed with an operational counting feature, the scale shall be marked on both the operator and customer sides with the statement "The counting feature is not legal for trade," except when a Class I or Class II prescription scale complies with all Handbook 44 requirements applicable to counting features.
    *[*Nonretroactive as of January 1, 1986.]*
    (Amended 1994 and 2003)

14. Required on *livestock** and railway track scales. When marked on vehicle and axle-load scales manufactured before January 1, 1989, it may be used as the CLC. For livestock scales manufactured between January 1, 1989 and January 1, 2003, required markings may be either CLC or section capacity.
    *[*Nonretroactive as of January 1, 2003.]*
    (Amended 2002 and 2003)

Table S.6.3.b.

Notes For Table S.6.3.a. (Continued)

15. *Required if the direction of loading the load cell is not obvious.*
[Nonretroactive as of January 1, 1988.]

16. *Serial number [Nonretroactive as of January 1, 1968] and prefix [Nonretroactive as of January 1, 1986]*. (See G-S.1.) Modules without "intelligence" on a modular system (e.g., printer, keyboard module, cash drawer, and secondary display in a point-of-sale system) are not required to have serial numbers.

17. *The accuracy Class of a device shall be marked on the device with the appropriate designation as I, II, III, III L, or IIII.*
[Nonretroactive as of January 1, 1986.]

18. The nominal capacity shall be conspicuously marked as follows:

(a) on any scale equipped with unit weights or weight ranges;
(b) on any scale with which counterpoise or equal-arm weights are intended to be used;
(c) on any automatic-indicating or recording scale so constructed that the capacity of the indicating or recording element, or elements, is not immediately apparent;
(d) on any scale with a nominal capacity less than the sum of the reading elements; and
*(e) on the load-receiving element (weighbridge) of vehicle, axle-load, and livestock scales.**
*[*Nonretroactive as of January 1, 1989.]*

19. *Nonretroactive as of January 1, 1988*.
(Amended 1992)

20. *Combination vehicle/railway track scales must be marked with both the nominal capacity and CLC for vehicle weighing and the nominal capacity and section capacity for railway weighing. All other requirements relating to these markings will apply.*
[Nonretroactive as of January 1, 2000]
(Added 1999)

21. The value of the load cell verification interval (v_{min}) must be stated in mass units. In addition to this information, a device may be marked with supplemental representations of v_{min}.
[*Nonretroactive as of January 1, 2001*]
(Added 1999)

22. *Combination vehicle/livestock scales must be marked with both the CLC for vehicle weighing and the section capacity for livestock weighing. All other requirements relative to these markings will apply.*
[Nonretroactive as of January 1, 2003]
(Added 2002)

Note: *The marked section capacity for livestock weighing may be less than the marked CLC for vehicle weighing.*
(Added 2003)

23. Required only if a CC has been issued for the device or equipment.
[Nonretroactive as of January 1, 2003]
(G-S.1. Identification (f) Added 2001)

24. The section capacity shall be prefaced by the words "Section Capacity" or an abbreviation of that term. Abbreviations shall be "Sec Cap" or "Sec C". All capital letters and periods may be used.
[Nonretroactive as of January 1, 2005]
(Added 2004)

N.1.2.1. Scales Marked I, II, III, or IIII. - Except for portable wheel load weighers, decreasing-load tests shall be conducted on scales marked I, II, III, or IIII and with n equal to or greater than 1000 with test loads equal to the maximum test load at each tolerance value. For example, on a Class III scale, at test loads equal to 4000d, 2000d, and 500d; for scales with n less than 1000, the test load shall be equal to one-half of the maximum load applied in the increasing-load test. (See Table 6.)
(Amended 1998)

N.1.2.2. All Other Scales. - On all other scales, except for portable wheel load weighers, the decreasing-load test shall be conducted with a test load equal to one-half of the maximum load applied in the increasing-load test.
(Amended 1998)

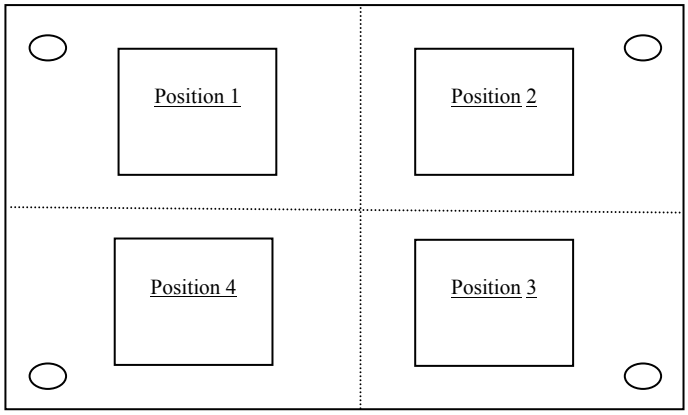
N.1.3. Shift Test.

N.1.3.1. Bench or Counter Scales. - A shift test shall be conducted with a half-capacity test load centered successively at four points equidistant between the center and the front, left, back, and right edges of the load-receiving element.

N.1.3.2. Dairy-Product-Test Scales. - A shift test shall be conducted with a test load of 18 grams successively positioned at all points on which a weight might reasonably be placed in the course of normal use of the scale.

N.1.3.3. Equal-Arm Scales. - A shift test shall be conducted with a half-capacity test load positioned on each pan as prescribed in N.1.3.1. An equal test load shall be centered on the other pan.

(b) A one-half nominal capacity test load centered as nearly as possible, successively at the center of each quarter of the load-receiving element as shown in the diagram below.



= Load Bearing Point

(Added 2003)

N.1.4. Sensitivity Test. - A sensitivity test shall be conducted on nonautomatic-indicating (weighbeam) scales only, with the weighing device in equilibrium at zero-load and at maximum test load. The test shall be conducted by increasing or decreasing the test load in an amount equal to the applicable value specified in T.2. or T.N.6.

N.1.5. Discrimination Test. *- A discrimination test shall be conducted on all automatic indicating scales with the weighing device in equilibrium at or near zero load and at or near maximum test load, and under controlled conditions in which environmental factors are reduced to the extent that they will not affect the results obtained. For scales equipped with an Automatic Zero-Setting Mechanism (AZSM), the discrimination test may be conducted at a range outside of the AZSM range.*
[Nonretroactive as of January 1, 1986.]
(Added 1985) (Amended 2004)

N.1.5.1. Digital Device. - On a digital device, this test is conducted from just below the lower edge of the zone of uncertainty for increasing load tests, or from just above the upper edge of the zone of uncertainty for decreasing-load tests.

N.1.6. RFI Susceptibility Tests, Field Evaluation. - An RFI test shall be conducted at a given installation when the presence of RFI has been verified and characterized if those conditions are considered "usual and customary."
(Added 1986)

N.1.7. Ratio Test. - A ratio test shall be conducted on all scales employing counterpoise weights and on nonautomatic-indicating equal-arm scales.

N.1.8. Material Tests. - A material test shall be conducted on all customer-operated bulk weighing systems for recycled materials using bulk material for which the device is used. Insert into the device, in a normal manner, several accurately preweighed samples (free of foreign material) in varying amounts approximating average drafts.

N.1.9. Zero-Load Balance Change. - A zero-load balance change test shall be conducted on all scales after the removal of any test load. The zero-load balance should not change by more than the minimum tolerance applicable. (Also see G-UR.4.2.) (Renumbered 1988)

N.1.10. Counting Feature Test. – A test of the counting function shall be conducted on all Class I and Class II prescription scales having an active counting feature used in "legal for trade" applications. The test should verify that the scale will not accept a sample with less than either the minimum sample piece count or the minimum sample weight of 30 e. Counting feature accuracy should be verified at a minimum of two test loads. Verification of the count calculations shall be based upon the weight indication of the test load.

Note:

(1) The minimum sample weight is equal to the marked minimum invidiual piece weight times the marked minimum sample piece count.

(2) Test load as used in this section refers to actual calibration test weights selected from an appropriate test weight class.

(Added 2003)

N.1.11. Substitution Test. – In the substitution test procedure, material or objects are substituted for known test weights, or a combination of known test weights and previously quantified material or objects, using the scale under test as a comparator. Additional test weights or other known test loads may be added to the known test load to evaluate higher weight ranges on the scale.
(Added 2003)

N.1.12. Strain-Load Test. – In the strain load test procedure, an unknown quantity of material or objects are used to establish a reference load or tare to which test weights or substitution test loads are added.
(Added 2003)

N.2. Verification (Testing) Standards. - Field standard weights used in verifying weighing devices shall comply with requirements of NIST Handbook 105-1 (Class F) or the tolerances expressed in Fundamental Considerations, paragraph 3.2. (i.e., one-third of the smallest tolerance applied).
(Amended 1986)

TABLE 4. RECOMMENDED[2] MINIMUM TEST WEIGHTS AND TEST LOADS[1]			
Device Capacity (Pounds)	Recommended[2] minimums (in terms of device capacity)		Recommended[2] (where practicable)
	Test Weights (greater of)	Test Loads	
0 to 100	105%		
101 to 1,000	50% or 100 lb	105%	
1,001 to 40,000	25% or 500 lb	50%	Test weights to dial face capacity, 1,000d or test load to used capacity, if greater than minimums specified
40,000 +	12.5% or 10,000 lb	25%	

[1] The term "test load" means the sum of the combination of field standard test weights and any other applied load used in the conduct of a test using substitution or build-up test methods.

Except for railway track scales, the recommended[2] minimum test of a Class III L scale shall consist of one test from zero to at least 25% of the scale capacity and then one strain load test to at least the used capacity of the device.

Each test is to be conducted using a known test load of at least 25% of scale capacity. This test load may be comprised entirely of test weights or a combination of test weights equal to at least 12.5% of scale capacity and a substitution load.

[2] The word "Recommended" will be deleted from this section as of January 1, 1998. This will make the amounts of test weights and test loads specified in Table 4 mandatory as of January 1, 1998.

N.3. Minimum Test Weights and Test Loads*.

[NOT ADOPTED]

4002.2 Scales (2.20)

(a) Recommended Minimum[2] Test Weights and Test Loads.[1] The recommended[2] minimum test weights and test loads for in-service tests (except railway track scales) are shown in Table 4. [See Table 4 for [1] and [2]]

N.3.1. Minimum Test-Weight Load and Recommended Strain-Load Test for Railway Track Scales.
(Amended 1990)

N.3.1.1. Approval. - The test-weight load shall be not less than 35 000 kg (80 000 lb). A strain-load test conducted up to the used capacity of the weighing system is recommended.
(Added 1990)

N.3.1.2. Interim Approval. - A test-weight load of not less than 13 500 kg (30 000 lb) and a strain-load test up to at least 25 percent of scale capacity may be used to return a scale into service following repairs.
(Added 1990)

Note: The length of time the scale may be used following an interim test is at the discretion of the official with statutory authority.
(Added 1990)

N.3.1.3. Enforcement Action for Inaccuracy. - To take enforcement action on a scale that is found to be inaccurate, a minimum test load of 13 500 kg (30 000 lb) must be used.
(Added 1990)

N.3.2. Field Standard Weight Carts. – Field Standard Weight Carts that comply with the tolerances expressed in Fundamental Considerations, paragraph 3.2. (i.e., one-third of the smallest tolerance applied) may be included as part of the minimum required test load for shift tests and other test procedures.
(Added 2004)

T.N.6.1. Test Load.

(a) The test load for sensitivity for nonautomatic-indicating vehicle, axle-load, livestock, and animal scales shall be 1d for scales equipped with balance indicators, and 2d or 0.2 percent of the scale capacity, whichever is less, for scales not equipped with balance indicators.

(b) For all other nonautomatic-indicating scales, the test load for sensitivity shall be 1d at zero and 2d at maximum test load.

T.N.6.2. Minimum Change of Indications. - The addition or removal of the test load for sensitivity shall cause a minimum permanent change as follows:

(a) for a scale with trig loop but without a balance indicator, the position of the weighbeam shall change from the center to the outer limit of the trig loop;

(b) for a scale with balance indicator, the position of the indicator shall change one division on the graduated scale, the width of the central target area, or the applicable value as shown below, whichever is greater;

Scale of Class I or II: 1 mm (0.04 in),

Scale of Class III or IIII with a maximum capacity of 30 kg (70 lb) or less: 2 mm (0.08 in),

Scale of Class III, III L, or IIII with a maximum capacity of more than 30 kg (70 lb): 5 mm (0.20 in);

(c) for a scale without a trig loop or balance indicator, the position of rest of the weighbeam or lever system shall change from the horizontal or midway between limiting stops to either limit of motion.

(Amended 1987)

T.N.7. Discrimination.

T.N.7.1. Analog Automatic Indicating (i.e., Weighing Device With Dial, Drum, Fan, Etc.). - A test load equivalent to 1.4d shall cause a change in the indication of at least 1.0d. (See N.1.5.)

T.N.7.2. Digital Automatic Indicating. - A test load equivalent to 1.4d shall cause a change in the indicated or recorded value of at least 2.0d. This requires the zone of uncertainty to be not greater than three-tenths of the value of the scale division. (See N.1.5.1.)

T.N.8. Influence Factors. - The following factors are applicable to tests conducted under controlled conditions only, provided that:

(a) types of devices approved prior to January 1, 1986, and manufactured prior to January 1, 1988, need not meet the requirements of this section, and

(b) new types of devices submitted for approval after January 1, 1986, shall comply with the requirements of this section, and

(c) all devices manufactured after January 1, 1988, shall comply with the requirements of this section.

(Amended 1985)

T.N.8.1. Temperature. - Devices shall satisfy the tolerance requirements under the following temperature conditions:

T.N.8.1.1. If not specified in the operating instructions for Class I or II scales, or if not marked on the device for Class III, III L, or IIII scales, the temperature limits shall be:

-10 °C to 40 °C (14 °F to 104 °F)

T.N.8.1.2. If temperature limits are specified for the device, the range shall be at least that specified in Table T.N.8.1.2.

Table T.N.8.1.2.
Temperature Range by Class

Class	Temperature Range
I	5 °C (9 °F)
II	15 °C (27 °F)
III, III L, & IIII	30 °C (54 °F)

T.N.8.1.3. Temperature Effect on Zero-Load Balance. - The zero-load indication shall not vary by more than:

(a) three divisions per 5 °C (9 °F) change in temperature for Class III L devices; or

(b) one division per 5 °C (9 °F) change in temperature for all other devices.

(Amended 1990)

T.N.8.1.4. Operating Temperature. - Except for Class I and II devices, an indicating or recording element shall not display nor record any usable values until the operating temperature necessary for accurate weighing and a stable zero balance condition have been attained.

T.N.8.2. Barometric Pressure. - Except for Class I scales, the zero indication shall not vary by more than one scale division for a change in barometric pressure of 1 kPa over the total barometric pressure range of 95 kPa to 105 kPa (28 to 31 in of Hg).

T.N.8.3. Electric Power Supply.

T.N.8.3.1. Power Supply, Voltage and Frequency.

(a) Weighing devices that operate using alternating current must perform within the conditions defined in paragraphs T.N.3. through T.N.7., inclusive, when tested over the range of -15% to +10% of the marked nominal line voltage(s) at 60 Hz, or the voltage range marked by the manufacturer, at 60 Hz.
(Amended 2003 and 2004)

(b) Battery operated instruments shall not indicate nor record values outside the applicable tolerance limits when battery power output is excessive or deficient.

T.N.8.3.2. Power Interruption. - A power interruption shall not cause an indicating or recording element to display or record any values outside the applicable tolerance limits.

T.N.9. Radio Frequency Interference (RFI) and Other Electromagnetic Interference Susceptibility. - The difference between the weight indication due to the disturbance and the weight indication without the disturbance shall not exceed one scale division (d); or the equipment shall:

(a) blank the indication, or

(b) provide an error message, or

(c) the indication shall be so completely unstable that it cannot be interpreted, or transmitted into memory or to a recording element, as a correct measurement value.
(Added 1986)

The tolerance in T.N.9. is to be applied independently of other tolerances. For example, if indications are at allowable basic tolerance error limits when the disturbance occurs, then it is acceptable for the indication to exceed the applicable basic tolerances during the disturbance. [Editors' Note: Following the 1997 NCWM Annual Meeting, the text in this paragraph was revised with concurrence of the S&T Committee to clarify its application.]
(Amended 1997)

UR. User Requirements

UR.1. Selection Requirements. - Equipment shall be suitable for the service in which it is used with respect to elements of its design, including but not limited to, its capacity, number of scale divisions, value of the scale division or verification scale division, minimum capacity, and computing capability.[4]

UR.1.1. General.

(a) For devices marked with a class designation, the typical class or type of device for particular weighing applications is shown in Table 7a.

(b) For devices not marked with a class designation, Table 7b applies.

[4] Purchasers and users of scales such as railway track, hopper, and vehicle scales should be aware of possible additional requirements for the design and installation of such devices.
(Footnote Added 1995)

Table 7a.
Typical Class or Type of Device for Weighing Applications

Class	Weighing Application or Scale Type
I	Precision laboratory weighing
II	Laboratory weighing, precious metals and gem weighing, grain test scales
III	All commercial weighing not otherwise specified, grain test scales, retail precious metals and semi-precious gem weighing, animal scales, postal scales, scales used to determine laundry charges, and vehicle on-board weighing systems
III L	Vehicle, axle-load, livestock, railway track scales, crane, hopper (other than grain hopper) scales, and vehicle on-board weighing systems
IIII	Wheel-load weighers and portable axle-load weighers used for highway weight enforcement

Note: A scale with a higher accuracy class than that specified as "typical" may be used.
(Amended 1985, 1986, 1987, 1988, 1992, 1995 and 2004)

UR.3.1.1. Minimum Load, Grain Dockage Determination. - When determining the quantity of foreign material (dockage) in grain, the weight of the sample shall be equal to or greater than 500 scale divisions.
(Added 1985)

UR.3.2. Maximum Load. - A scale shall not be used to weigh a load of more than the nominal capacity of the scale.

UR.3.2.1. Maximum Loading for Vehicle Scales. - A vehicle scale shall not be used to weigh loads exceeding the maximum load capacity of its span as specified in Table UR.3.2.1.
(Added 1996)

UR.3.3. Single-Draft Vehicle Weighing. - A vehicle or a coupled vehicle combination shall be commercially weighed on a vehicle scale only as a single draft. That is, the total weight of such a vehicle or combination shall not be determined by adding together the results obtained by separately and not simultaneously weighing each end of such vehicle or individual elements of such coupled combination. However:

(a) the weight of a coupled combination may be determined by uncoupling the various elements (tractor, semitrailer, trailer), weighing each unit separately as a single draft, and adding together the results, or

(b) the weight of a vehicle or coupled-vehicle combination may be determined by adding together the weights obtained while all individual elements are resting simultaneously on more than one scale platform.

[Note: This paragraph does not apply to highway-law-enforcement scales and scales used for the collection of statistical data.]
(Added 1992)

UR.3.4. Wheel-Load Weighing.

UR.3.4.1. Use in Pairs. - When wheel-load weighers or portable axle-load weighers are to be regularly used in pairs, both weighers of each such pair shall be appropriately marked to identify them as weighers intended to be used in combination.

UR.3.4.2. Level Condition. – A vehicle of which either an axle-load determination or a gross-load determination is being made utilizing wheel-load weighers or portable axle-load weighers, shall be in a reasonably level position at the time of such determination.

UR.3.5. Special Designs. - A scale designed and marked for a special application (such as a prepackaging scale or prescription scale with a counting feature) shall not be used for other than its intended purpose.[4]
(Amended 2003)

UR.3.6. Wet Commodities. - Wet commodities not in watertight containers shall be weighed only on a scale having a pan or platform that will drain properly.
(Amended 1988)

UR.3.7. Minimum Load on a Vehicle Scale.
[NOT ADOPTED]

4002.2. Scales (2.20.)

(b) Minimum Load on a Vehicle Scale. Except for weighments of ferrous metals, cardboard, paper, rags or plastic, and the weighing of vehicles for registration purposes, a vehicle scale shall not be used for weighing net loads less than the value of 20 scale divisions.

4002.2. Scales (2.20.)

(c) Class III, Class III L and Unmarked Devices Used For Recycling. Except for weighments of ferrous metals, cardboard, paper, rags, or plastic, Class III, Class III L and unmarked devices used in recycling shall not be used for weighing net loads less than the value of 20 scale divisions.

[4] Prepackaging scales and prescription scales with a counting feature (and other commercial devices) used for putting up packages in advance of sale are acceptable for use in commerce only if all appropriate provisions of Handbook 44 are met. Users of such devices must be alert to the legal requirements relating to the declaration of quantity on a package. Such requirements are to the effect that, on the average, the contents of the individual packages of a particular commodity comprising a lot, shipment, or delivery must contain at least the quantity declared on the label. The fact that a prepackaging scale may overregister, but within established tolerances, and is approved for commercial service is not a legal justification for packages to contain, on the average, less than the labeled quantity.
(Amended 2003)

UR.3.8. Minimum Load for Weighing Livestock. - A scale with scale divisions greater than 2 kg (5 lb) shall not be used for weighing net loads smaller than 500d.
(Amended 1989)

UR.3.9. Use of Manual Weight Entries. - Manual gross or net weight entries are permitted for use in the following applications only:

(1) when a point-of-sale system interfaced with a scale is giving credit for a weighed item;

(2) when an item is pre-weighed on a legal for trade scale and marked with the correct net weight;

(3) when a device or system is generating labels for standard weight packages;

(4) when postal scales or weight classifiers are generating manifests for packages to be picked up at a later time; or

(5) when livestock and vehicle scale systems generate weight tickets to correct erroneous tickets.

(Added 1992) (Amended 2000 and 2004)

UR.3.10. Dynamic Monorail Weighing Systems. – When the value of d is different from the value of e, the commercial transaction must be based on e.
(Added 1999)

UR.3.11. Minimum Count. – A prescription scale with an operational counting feature shall not be used to count a quantity of less than 30 pieces weighing a minimum of 90 e.
(Added 2003) (Amended 2004)

Note: The minimum count as defined in this paragraph refers to the use of the device in the filling of prescriptions and is different from the minimum sample piece count as defined in S.1.2.3. and as required to be marked on the scale by S.6.6.
(Note Added 2004)

UR.3.12. Correct Stored Piece Weight. – For prescription scales with a counting feature, the user is responsible for maintaining the correct stored piece weight. This is especially critical when a medicine has been reformulated or comes from different lots.
(Added 2003)

UR.4. Maintenance Requirements.

UR.4.1. Balance Condition. - The zero-load adjustment of a scale shall be maintained so that, with no load on the load-receiving element and with all load-counter-balancing elements of the scale (such as poises, drop weights, or counterbalance weights) set to zero, the scale shall indicate or record a zero balance condition. A scale not equipped to indicate or record a zero-load balance shall be maintained in balance under any no-load condition.

UR.4.2. Level Condition. - If a scale is equipped with a level-condition indicator, the scale shall be maintained in level.

UR.4.3. Scale Modification. - The dimensions (e.g., length, width, thickness, etc.) of the load receiving element of a scale shall not be changed beyond the manufacturer's specifications, nor shall the capacity of a scale be increased beyond its design capacity by replacing or modifying the original primary indicating or recording element with one of a higher capacity, except when the modification has been approved by a competent engineering authority, preferably that of the engineering department of the manufacturer of the scale, and by the weights and measures authority having jurisdiction over the scale.
(Amended 1996)

UR.5. Coupled-in-Motion Railroad Weighing Systems.- A coupled-in-motion weighing system placed in service on or after January 1, 1991, should be tested in the manner in which it is operated, with the locomotive either pushing or pulling the cars at the designed speed and in the proper direction. The cars used in the test train should represent the range of gross weights that will be used during the normal operation of the weighing system. Except as provided in N.4.2. and N.4.3.(a), normal operating procedures should be simulated as nearly as practical. Approach conditions for a train length in each direction of the scale site are more critical for a weighing system used for individual car weights than for a unit-train-weights-only facility, and should be considered prior to installation.
(Added 1990) (Amended 1992)

Sec. 2.21. Belt-Conveyor Scale Systems

A. Application

A.1. This code applies to belt-conveyor scale systems used for the weighing of bulk materials.

A.2. The code does not apply to:

(a) devices used for discrete weighing while moving on conveyors;

(b) devices that measure quantity on a time basis;

(c) check-weighers; or

(d) controllers or other auxiliary devices except as they may affect the weighing performance of the belt-conveyor scale.

A.3. See also General Code requirements.

S. Specifications

S.1. Design of Indicating and Recording Elements.

S.1.1. General. - A belt-conveyor scale shall be equipped with a primary indicating element in the form of a master weight totalizer *and shall also be equipped with a recording element, and a rate of flow indicator and recorder (which may be analog).** An auxiliary indicator shall not be considered part of the master weight totalizer.
*[*Nonretroactive as of January 1, 1986.]*
(Amended 1986)

S.1.2. Units. - A belt-conveyor scale shall indicate and record weight units in terms of pounds, tons, long tons, metric tons, or kilograms. The value of a scale division (d) expressed in a unit of weight shall be equal to:

(a) 1, 2, or 5, or

(b) a decimal multiple or submultiple of 1, 2, or 5.

S.1.3. Value of the Scale Division.

S.1.3.1. For Scales Installed After January 1, 1986. *The value of the scale division shall not be greater than 0.1 percent (1/1 000) of the minimum totalized load.*
[Nonretroactive as of January 1, 1986.]

S.1.3.2. For Scales Installed Before January 1, 1986. - The value of the scale division shall not be greater than 1/1200 of the rated capacity of the device. However, provision shall be made so that compliance with the requirements of the zero-load test as prescribed in N.3.1. may be readily and accurately determined in 20 minutes of operation.

S.1.4. Recording Elements and Recorded Representations. - *The value of the scale division of the recording element shall be the same as that of the indicating element. The belt-conveyor scale system shall record the initial indication and the final indication of the master weight totalizer*, the quantity delivered*, the unit of measurement (i.e., kilograms, tonnes, pounds, tons, etc.), the date, and time. This information shall be recorded for each delivery*.*
[Nonretroactive as of January 1, 1986.]
*[*Nonretroactive as of January 1, 1994.]*
(Amended 1993)

S.1.4.1. *The belt-conveyor scale system shall be capable of recording the results of automatic or semi-automatic zero load tests.***
*[**Nonretroactive as of January 1, 2004.]*
(Added 2002)

S.1.5. Rate of Flow Indicators and Recorders. - *A belt-conveyor scale shall be equipped with a rate of flow indicator and an analog or digital recorder. Permanent means shall be provided to produce an audio or visual signal when the rate of flow is equal to or less than 20% and when the rate of flow is equal to or greater than 100% of the rated capacity of the scale. The type of alarm (audio or visual) shall be determined by the individual installation.*
[Nonretroactive as of January 1, 1986.]
(Amended 1989 and 2004)

S.1.6. Advancement of Primary Indicating or Recording Elements. - The master weight totalizer shall advance only when the belt conveyor is in operation and under load.
(Amended 1989)

S.1.7. Master Weight Totalizer. - *The master weight totalizer shall not be resettable without breaking a security means.*
[Nonretroactive as of January 1, 1986.]

S.1.8. Power Loss. - *In the event of a power failure of up to 24 hours, the accumulated measured quantity on the master weight totalizer of an electronic digital indicator shall be retained in memory during the power loss.*
[Nonretroactive as of January 1, 1986.]
(Amended 1989)

S.2. Design of Weighing Elements. - A belt-conveyor scale system shall be designed to combine automatically belt travel with belt load to provide a determination of the weight of the material that has passed over the scale.

S.2.1. Speed Measurement. - A belt-conveyor scale shall be equipped with a belt speed or travel sensor that will accurately sense the belt speed or travel whether the belt is empty or loaded.

S.2.2. Adjustable Components. - An adjustable component that can affect the performance of the device (except as prescribed in S.3.1) shall be held securely in adjustment and shall not be capable of adjustment without breaking a security means.

S.2.3. Overload Protection. - The load-receiving elements shall be equipped with means for overload protection of not less than 150 percent of rated capacity. The accuracy of the scale in its normal loading range, shall not be affected by overloading.

S.3. Zero Setting.

S.3.1. Design of Zero-Setting Mechanism. - Automatic and semiautomatic zero-setting mechanisms shall be so constructed that the resetting operation is carried out only after a whole number of belt revolutions and the completion of the setting or the whole operation is indicated. *An audio or visual signal shall be given when the automatic and semiautomatic zero-setting mechanisms reach the limit of adjustment of the zero-setting mechanism.**

Except for systems that do not record the zero load reference at the beginning and end of a delivery, the range of the zero-setting mechanism shall not be greater than ±2 percent of the rated capacity of the scale without breaking the security means. *For systems that record the zero load reference at the beginning and end of a delivery, the range of zero-setting mechanism shall not be greater than ±5 percent without breaking the security means.***

*[*Nonretroactive as of January 1, 1990]*
*[**Nonretroactive as of January 1, 2004]*
(Amended 1989 and 2002)

S.3.2. Sensitivity at Zero Load (For Type Evaluation). - *When a system is operated for a time period equal to the time required to deliver the minimum test load and with a test load calculated to indicate two scale divisions applied directly to the weighing element, the totalizer shall advance not less than one or more than three scale divisions. An alternative test of equivalent sensitivity, as specified by the manufacturer, shall also be acceptable.*
[Nonretroactive as of January 1, 1986.]

S.4. Marking Requirements. - A belt-conveyor scale shall be marked with the following: (Also see G-S.1.)

(a) the rated capacity in units of weight per hour (minimum and maximum);

(b) the value of the scale division;

(c) the belt speed in terms of feet (or meters) per minute at which the belt will deliver the rated capacity;

(d) the load in terms of pounds per foot or kilograms per meter (determined by materials tests);

(e) the operational temperature range if other than -10 to 40 °C (14 to 104 °F).
[Nonretroactive as of January 1, 1986.]

S.5. Provision for Sealing. - *A device shall be designed using the format set forth in Table S.5. with provision(s) for applying a security seal that must be broken, or for using other approved means of providing security (e.g. data change audit trail available at the time of inspection), before any change that affects the metrological integrity of the device can be made to any electronic mechanism.*
[Nonretroactive as of January 1, 1999]
Added 1998)

Table S.5. Categories of Device and Methods of Sealing

Categories of Devices	*Method of Sealing*
Category 1: No remote configuration capability.	*Seal by physical seal or two event counters: one for calibration parameters and one for configuration parameters.*
Category 3: Remote configuration capability.	*An event logger is required in the device; it must include an event counter (000 to 999), the parameter ID, the date and time of the change, and the new value of the parameter. A printed copy of the information must be available through the device or through another on-site device. The event logger shall have a capacity to retain records equal to ten times the number of sealable parameters in the device, but not more than 1000 records are required. (Note: Does not require 1000 changes to be stored for each parameter.)*

(Nonretroactive as January 1, 1998) (Table Added 1998)

N. Notes

N.1. General. - Belt-conveyor scales are capable of weighing bulk material accurately. (See Tolerances.) However, their performance can be detrimentally affected by the conditions of the installation. (See User Requirements.) The performance of the equipment is not to be determined by averaging the results of the individual tests. The results of all tests shall be within the tolerance limits.
(Amended 2002)

N.1.1. Official Test. - An official test of a belt-conveyor scale system shall be a materials test.

N.1.2. Simulated Test. - Simulated loading conditions as recommended by the manufacturer and approved by the official with statutory authority may be used to properly monitor the systems operational performance between official tests, but shall not be used for official certification.
(Amended 1991)

N.2. Conditions of Tests. - A belt-conveyor scale shall be tested after it is installed on the conveyor system with which it is to be used and under such environmental conditions as may normally be expected. Each test shall be conducted with test loads no less than the minimum test load.
(Amended 1986 and 2004)

N.2.1. Initial Verification. – A belt-conveyor scale system shall be tested at the normal use flow rate, 35% of the maximum rated capacity, and an intermediate flow rate between these two points. The system may also be tested at any other rate of flow that may be used at the installation.
(Added 2004)

N.2.2. Subsequent Verification. – Subsequent testing shall include testing at the normal use flow rate and other flow rates used at the installation. The official with statutory authority may determine that testing only at the normal use flow rate is necessary for subsequent verifications if evidence is provided that the system is used to operate:

(a) at no less than 70% of the maximum rated capacity for at least 80% of the time (excluding time that the belt is unloaded), or

(b) with a normal use flow rate that does not vary by more than 10% of the maximum rated capacity.

Example: If a belt-conveyor scale system has a maximum rated capacity of 200 tons per hour (tph), and the normal use flow rate is 150 tph (75% of the maximum rated capacity), no testing at additional flow rates is required provided the flow rates remain above 140 tph for more than 80% of the time. If the same device were operating with a normal use flow rate of 130 tph, it is operating at 65% of the maximum rated capacity. In this case, testing at flow rates in addition to the normal use flow rate would be required if the nrmal use flow rate varies by more than 20 tph (10% of the maximum rated capacity).
(Added 2004)

N.2.3. Minimum Test Load. – The minimum test load shall not be less than the largest of the following values.

(a) 800 scale divisions,

(b) the load obtained at maximum flow rate in one revolution of the belt, or

(c) at least 10 minutes of operation.

The official with statutory authority may determine that a smaller minimum totalized load down to 2% of the load totalized in one hour at the maximum flow rate may be used for subsequent tests, provided that:

1. the smaller minimum totalized load is greater than the quantities specified in (a) and (b), and

2. consecutive official testing with the minimum totalized loads described in N.2.3. (a), (b), or (c) and the smaller minimum test load has been conducted that demonstrates the system complies with applicable tolerances for repeatability, acceptance, and maintenance.

(Added 2004)

N.3. Test Procedures.

N.3.1. Zero Load Tests. - A zero-load test shall be conducted to establish that the belt scale system (including the conveyor) is capable of holding a stable, in-service zero.
(Amended 1989 and 2002)

N.3.1.1. Determination of Zero. - A "Zero-Load Test" is a determination of the error in zero, expressed as an internal reference, a percentage of the full-scale capacity, or a change in a totalized load over a whole number of complete belt revolutions. For belt-conveyor scales with electronic integrators, the test must be performed over a period of at least 3 minutes and with a whole number of complete belt revolutions. For belt-conveyor scales with mechanical integrators, the test shall be performed with no less than three complete revolutions or 10 minutes operation, whichever is greater.
(Added 2002)

N.3.1.2. Initial Stable Zero. - The conveyor system shall be run to warm up the belt and the belt scale shall be zero adjusted as required. A series of zero-load tests shall be carried out until three consecutive zero-load tests each indicate an error which does not exceed ± 0.06% of the totalized load at full scale capacity for the duration of the test. No adjustments can be made during the three consecutive zero-load test readings.
(Added 2002) (Amended 2004)

N.3.1.3. Test of Zero Stability. - The conveyor system shall be operated to warm up the belt and the belt scale shall be zero adjusted as required. A series of zero-load tests shall be carried out immediately before the simulated or materials test until the three consecutive zero-load tests each indicate an error which does not exceed ± 0.06% of the totalized load at full scale capacity for the duration of the test. No adjustments can be made during the three consecutive zero-load test readings.
(Added 2002) (Amended 2004)

N.3.1.4. Check For Consistency of the Conveyor Belt Along Its Entire Length. - After a zero-load test with flow rate filtering disabled, the totalizer shall not change more than plus or minus (± 3d) three scale divisions from its initial indication during one complete belt revolution.
(Added 2002) (Amended 2004)

N.3.2. Material Tests. – Material tests should be conducted using actual belt loading conditions. These belt loading conditions shall include, but are not limited to conducting materials tests using different belt loading points, all types and sizes of products weighed on the scale, at least one other belt speed, and in both directions of weighing.

On initial verification, at least three individual tests shall be conducted. On subsequent verifications, at least two individual tests shall be conducted. The results of all these tests shall be within the tolerance limits.

Either pass a quantity of pre-weighed material over the belt-conveyor scale in a manner as similar as feasible to actual loading conditions, or weigh all material that has passed over the belt-conveyor scale. Means for weighing the material test load will depend on the capacity of the belt-conveyor scale and availability of a suitable scale for the test. To assure that the test load is accurately weighed and determined, the following precautions shall be observed:
(Amended 2002)

(a) The containers, whether railroad cars, trucks, or boxes, must not leak, and shall not be overloaded to the point that material will be lost.

(b) The actual empty or tare weight of the containers shall be determined at the time of the test. Stenciled tare weight of railway cars or trucks shall not be used. Gross and tare weights shall be determined on the same scale.

(c) When a pre-weighed test load is passed over the scale, the belt loading hopper shall be examined before and after the test to assure that the hopper is empty and that only the material of the test load has passed over the scale.

(d) Where practicable, a reference scale should be tested within 24 hours preceding the determination of the weight of the test load used for a belt-conveyor scale material test.

A reference scale which is not "as found" within maintenance tolerance should have its accuracy re-verified after the belt-conveyor test with a suitable known weight load if the "as found" error of the belt-conveyor scale material test exceeds maintenance tolerance values.

(e) If any suitable known weight load other than a certified test weight load is used for re-verification of the reference scale accuracy, its weight shall be determined on the reference scale after the reference scale certification and before commencing the belt scale material test.

Note: Even if the reference scale is within maintenance tolerance it may require adjusting to be able to meet paragraph N.3.2.1.

(f) The test shall not be conducted if the weight of the test load has been affected by environmental conditions.
(Amended 1986, 1989, 1998, 2000 and 2002)

N.3.2.1. Accuracy of Material. - The quantity of material used to conduct a material test shall be weighed on a reference scale to an accuracy within 0.1 percent. Scales typically used for this purpose include Class III and III L scales or a scale without a class designation as described in Handbook 44, Section 2.20, Table T.1.1.
(Added 1989) (Amended 1991, 1993, 1998 and 2000)

N.3.3. Simulated Load Tests.

(a) As required by the official with statutory authority, simulated load tests as recommended by the manufacturer are to be conducted between material tests to monitor the system's operational performance, but shall not be used for official certification.
(Amended 1991)

(b) A simulated load test consisting of at least three consecutive test runs shall be conducted as soon as possible, but not more than 12 hours after the completion of the material test, to establish the factor to relate the results of the simulated load test to the results of the material tests.
(Added 1990)

(c) The results of the simulated load test shall repeat within 0.1%.
(Added 1990)
(Amended 1989 and 1990)

T. Tolerances

T.1. Tolerance Values[1]. - Maintenance and acceptance tolerances on materials tests, relative to the weight of the material, shall be ± 0.25% of the test load.
(Amended 1993)

T.1.1. Tolerance Values – Test of Zero Stability. Immediately after material has been weighed over the belt-conveyor scale during the conduct of the materials test, the zero-load test shall be repeated. The change in the accumulated or subtracted weight on the Master Weight Totalizer during the zero test shall not exceed 0.12% of the totalized load at full scale capacity for the duration of the test.
(Added 2004)

T.2. Tolerance Values, Repeatability Tests. - The variation in the values obtained during the conduct of materials tests shall not be greater than 0.25 percent (1/400).

T.3. Influence Factors. - The following factors are applicable to tests conducted under controlled conditions only, provided that:

(a) types of devices approved prior to January 1, 1986, and manufactured prior to January 1, 1988, need not meet the requirements of this Section; and

(b) new types of devices submitted for approval after January 1, 1986, shall comply with the requirements of the Section; and

(c) all devices manufactured after January 1, 1988, shall comply with the requirements of this Section.

T.3.1. Temperature. - Devices shall satisfy the tolerance requirements at temperatures from -10 °C to 40 °C (14 °F to 104 °F).

T.3.1.1. Effect on Zero-Load Balance. - The zero-load indication shall not change by more than 0.035% of the rated capacity of the scale (without the belt) for a change in temperature of 10 °C (18 °F) at a rate not to exceed 5 °C (9 °F) per hour.
(Amended 2004)

T.3.1.2. Temperature Limits. - *If a temperature range other than -10 °C to 40 °C (14 °F to 104 °F) is specified for the device, the range shall be at least 30 °C (54 °F).*
[Nonretroactive as of January 1, 1990.]
(Added 1989)

T.3.2. Power Supply, Voltage and Frequency. - A belt-conveyor scale system shall satisfy the tolerance requirements over a range of 100 to 130 V or 200 to 250 V as appropriate and over a frequency range of 59.5 to 60.5 Hz.

UR. User Requirements

UR.1. Use Requirements. - A belt-conveyor scale system shall be operated between 20% and 100% of its rated capacity.
(Amended 2004)

UR.1.1. Minimum Totalized Load. - Delivered quantities of less than the minimum test load shall not be considered a valid weighment.

UR.1.2. Security Means. - When a security means has been broken, it shall be reported to the official with statutory authority.
(Amended 1991)

[1] The variables and uncertainties included in the relative tolerance represent only part of the variables that affect the accuracy of the material weighed on belt-conveyor scales. If this tolerance was based on an error analysis beginning with mass standards through all of the test processes and following the principle expressed in Section 3.2. of the Fundamental Considerations in Appendix A of Handbook 44, the tolerance would be 0.5 percent.
(Added 1993)

UR.2. Installation Requirements.

UR.2.1. Protection from Environmental Factors. - The indicating elements, the lever system or load cells, and the load-receiving element of a belt-conveyor scale shall be adequately protected from environmental factors such as wind, moisture, dust, weather, and radio frequency interference (RFI) and electromagnetic interference (EMI) that may adversely affect the operation or performance of the device.

UR.2.2. Conveyor Installation. - The design and installation of the conveyor leading to and from the belt-conveyor scale is critical with respect to scale performance. The conveyor may be horizontal or inclined, but if included, the angle shall be such that slippage of material along the belt does not occur. Installation shall be in accordance with the scale manufacturer's instructions and the following:
(Amended 2002)

(a) **Installation - General.** - A belt-conveyor scale shall be so installed that neither its performance nor operation will be adversely affected by any characteristic of the installation, including but not limited to, the foundation, supports, covers, or any other equipment.
(Amended 2002)

(b) **Live Portions of Scale.** - All live portions of the scale shall be protected with appropriate guard devices and clearances, as recommended by the scale manufacturer, to prevent accidental interference with the weighing operation. (Also see UR.3.2.)
(Amended 2004)

(c) **Storage of Simulated Load Equipment.** - Suitable protection shall be provided for storage of any simulated load equipment.

(d) **Take-up Device.** - If the belt length is such that a take-up device is required, this device shall be of the counter-weighted type for either vertical or horizontal travel.

(e) **Scale Location and Training Idlers.** - The scale shall be so installed that the first weigh idler of the scale is at least 6 m (20 ft) or 5 idler spaces, whichever is greater, from loading point, skirting, head or tail pulley, or convex curve in the conveyor. Any training idler shall be located at least 18 m (60 ft) from the center line of the weigh span of the scale. Training idlers shall not be restrained at any time in order to force belt alignment.
(Amended 1998)

(f) **Concave Curve.** - If there is a concave curve in the conveyor, before or after the scale, the scale shall be installed so that the belt is in contact with all the idler rollers at all times for at least 6 m (20 ft) or 5 idler spaces, whichever is greater, before and after the scale.[2] A concave curve shall start no closer than 12 m (40 ft) from the scale to the tangent point of the concave curve.
(Amended 1998)

(g) **Tripper and Movable Pulleys. -** There shall be no tripper or movable head pulleys in the conveyor.

(h) ***Conveyor Length.*** - *The conveyor shall be no longer than 300 m (1000 ft) nor shorter than 12 m (40 ft) from head to tail pulley.*
[Nonretroactive as of January 1, 1986.]

(i) **Conveyor Orientation** - The conveyor may be horizontal or inclined, but, if inclined, the angle shall be such that slippage of material along the belt does not occur.

(j) **Conveyor Stringers.** - Conveyor stringers at the scale and for not less than 6 m (20 ft) before and beyond the scale shall be continuous or securely joined and of sufficient size and so supported as to eliminate relative deflection between the scale and adjacent idlers when under load. The conveyor stringers should be so designed that the deflection between any two adjacent idlers within the weigh area does not exceed 0.6 mm (0.025 in) under load.

(k) **Identification of Scale Area.** - The scale area and 5 idlers on both ends of the scale shall be of a contrasting color, or other suitable means shall be used to distinguish the scale from the remainder of the conveyor installation, and the scale shall be readily accessible.
(Amended 1998)

[2] Installing the belt scale 5 idler spaces from the tail pulley or the infeed skirting will be in the area of least belt tension on the conveyor and should produce the best accuracy. The performance of a belt-conveyor scale may be adversely affected by a concave curve in the conveyor that is located between the loading point and the scale. Therefore, whenever possible, a belt-conveyor scale should not be installed with a concave curve in the conveyor between the loading point and the scale.
(Amended 1995 and 1998)

(l) **Belt Composition and Maintenance.** - Conveyor belting shall be no heavier than is required for normal use. In a loaded or unloaded condition, the belt shall make constant contact with horizontal and wing rollers of the idlers in the scale area. Splices shall not cause any undue disturbance in scale operation (see N.3.).
(Amended 1998, 2000 and 2001)

(m) **Uniformity of Belt Loading and Flow.** - The conveyor loading mechanism shall be designed to provide uniform belt loading. The distance from the loading point to the scale shall allow for adequate settling time of the material on the belt before it is weighed. Feeding mechanisms shall have a positive closing or stopping action so that material leakage does not occur. Feeders shall provide an even flow over the scale through the full range of scale operation. Sufficient impact idlers shall be provided in the conveyor under each loading point to prevent deflection of the belt during the time material is being loaded.

(n) **Belt Alignment.** - The belt shall not extend beyond the edge of the idler roller in any area of the conveyor.
(Amended 1998)
(Amended 2000)

UR.2.3. Material Test. *- A belt-conveyor scale shall be installed so that a material test can be conveniently conducted.*
[Nonretroactive as of January 1, 1981.]

UR.2.4. Belt Travel (Speed or Velocity). - The belt travel sensor shall be so positioned that it accurately represents the travel of the belt over the scale for all flow rates between the maximum and minimum values. The belt travel sensor shall be so designed and installed that there is no slip.

UR.3. Use Requirements.

UR.3.1. Loading. - The feed of material to the scale shall be controlled to assure that, during normal operation, the material flow is in accordance with manufacturer's recommendation for rated capacity.

UR.3.2. Maintenance. - Belt-conveyor scales and idlers shall be maintained and serviced in accordance with manufacturer's instructions and the following:

(a) The scale and area surrounding the scale shall be kept clean of debris or other foreign material that can detrimentally affect the performance of the system.

(b) There shall be provisions to ensure that weighed material does not adhere to the belt and return to the scale system area.
(Added 2004)

(c) Simulated load tests or material tests, and zero load tests shall be conducted at periodic intervals between official tests in order to provide reasonable assurance that the device is performing correctly.
(Amended 2004)

The action to be taken as a result of the material tests or simulated load tests is as follows:
(Amended 2000 and 2002)

- if the error is less than 0.25 percent, no adjustment is to be made;

- if the error is at least 0.25 percent but not more than 0.6 percent, adjustment may be made if the official with statutory authority is notified;
(Amended 1991)

- if the error is greater than 0.6 percent but does not exceed 0.75 percent, adjustments shall be made only by a competent service person and the official with statutory authority shall be notified. After such an adjustment, if the results of a subsequent test require adjustment in the same direction, an official test shall be conducted;
(Amended 1991)

- if the error is greater than 0.75 percent, an official test is required.
(Amended 1987)

(d) Scale Alignment. - Alignment checks shall be conducted in accordance with the manufacturer's recommendation when conveyor work is performed in the scale area. A material test is required after any realignment.
(Amended 1986, 2000 and 2004)

(e) Simulated Load Equipment. - Simulated load equipment shall be clean and properly maintained.
(Amended 2004)

(f) Zero Load Reference Information. – When zero load reference information is recorded for a delivery, the information must be based upon zero load tests performed as a minimum both immediately before and immediately after the totalized load.
(Added 2002) (Amended 2004)

UR.3.3. Retention of Maintenance, Test, and Analog or Digital Recorder Information. - Records of calibration and maintenance, including conveyor alignment, analog or digital recorder, zero-load test, and material test data shall be maintained on site for at least the three concurrent years as a history of scale performance. Copies of any report as a result of a test or repair shall be mailed to the official with statutory authority as required. The current date and correction factor(s) for simulated load equipment shall be recorded and maintained in the scale cabinet.
(Added 2002)

UR.4. Compliance. - Prior to initial verification, the scale manufacturer or installer shall certify to the owner that the scale meets code requirements. Prior to initial verification and each subsequent verification, the scale owner or his agent shall notify the official with statutory authority in writing that the belt-conveyor scale system is in compliance with this specification and ready for material testing.
(Amended 1991)

Section 2.24. Automatic Weighing Systems

The status of Sectios 2.24. Automatic Weighing Systems was changed from "tentative" to "permanent" effective January 1, 2005.

The National Type Evaluation Program (NTEP) has been evaluating devices under the provisions of this code since it was added to Handbook 44 in 1995. In addition, a number of weights and measures jurisdictions as well as organizations such as the U.S. Department of Agriculture (USDA) have implemented this code using the provisions of General Code Paragraph G-A.3. – Special and Unclassified Equipment. It is recommended that the jurisdictions that have not implemented this code work with industry to expedite the implementation of its use.

A. Application

A.1. This code applies to devices used to automatically weigh pre-assembled discrete loads or single loads or loose materials in applications where automatic weighing systems[1] are used or employed in the determination of quantities, things, produce, or articles for distribution, for purchase, offered or submitted for sale, for distribution, purchase, or in computing any basic charge or payment for services rendered on the basis of weight, and in packaging plants subject to regulation by the USDA. Some weigh-labelers and checkweighers may also include a scale that is incorporated in a conveyor system that weighs packages in a static or non-automatic weighing mode.[2]

This includes:

(a) Automatic weigh-labelers,

(b) Combination automatic and non-automatic weigh-labelers,

(c) Automatic checkweighers

(d) Combination automatic and non-automatic check-weighers, and

(e) Automatic gravimetric filling machines that weigh discrete loads or single loads of loose materials and determine package and production lot compliance with net weight representations.

(Amended 2001 and 2004)

A.2. This code does not apply to:

(a) Belt-Conveyor Scale Systems,

(b) Railway Track Scales,

(c) Monorail Scales,

(d) Automatic Bulk-Weighing Systems, or

(e) Devices that measure quantity on a time basis,

(f) Controllers or other auxiliary devices except as they may affect the weighing performance,

(g) Automatic gravimetric filling machines and other automatic weighing systems employed in determining the weight of a commodity in a plant or business with a separate quantity control program (e.g., a system of statistical process control) using suitable weighing instruments and measurement standards traceable to national standards to determine production lot compliance with net content representations.[3]
(Added 2004)

(Amended 2001 and 2004)

A.3. Also see General Code requirements.

---

[1] An automatic weighing system does not require the intervention of an operator during the weighing process. The necessity to give instructions to start a process or to release a load, or the function of the instrument (static, dynamic, setup, etc.) are not relevant in deciding the catetory of automatic or non-automatic instruments.
(Added 2004)

[2] Prepackaging scales (and other commercial devices) used for putting up packages in advance of sale are acceptable for use in commerce if all appropriate provisions of Handbook 44 are met. Users of such devices must be alert to the legal requirements relating to the declaration of quantity on a package. Such requirements are to the effect that, on the average, the contents of the individual packages of a particular commodity comprising a lot, shipment, or delivery must contain at least the quantity declared on the label. The fact that a scale or other commercial device may overregister, but within established tolerances, and is approved for commercial service is not a legal justification for packages to contain, on the average, less than the labeled quantity.
(Added 2004)

[3] See NIST Handbook 130, Uniform Laws and Regulations in the area of Legal Metrology and Engine Fuel Qualtity, Interpretations and Guidelines paragraph 2.6.11. Good Quantity Control Practices.

S. Specifications

S.1. Design of Indicating and Recording Elements and of Recorded Representations.

S.1.1. Zero Indication.

(a) A weigh-labeler shall be equipped with an indicating or recording element. Additionally, a weigh-labeler equipped with an indicating or recording element shall either indicate or record a zero-balance condition and an out-of-balance condition on both sides of zero. (Amended 2004)

(b) An automatic checkweigher may be equipped with an indicating or recording element.

(c) A zero-balance condition may be indicated by other than a continuous digital zero indication, provided that effective automatic means is provided to inhibit a weighing operation or to return to a continuous digital indication when the device is in an out-of-balance condition.

S.1.1.1. Digital Indicating Elements.

(a) A digital zero indication shall represent a balance condition that is within ± 1/2 scale division.

(b) A digital indicating device shall either automatically maintain a "center of zero" condition to ± 1/4 scale division or less, or have an auxiliary or supplemental "center-of-zero" indicator that defines a zero-balance condition to ± 1/4 scale division or less.

(c) Verification of the accuracy of the center of zero indication to ± 1/4 scale division or less during automatic operation is not required on automatic checkweighers. (Amended 2004)

S.1.2. Value of Division Units. The value of a division "d" expressed in a unit of weight shall be equal to:

(a) 1, 2, or 5; or

(b) a decimal multiple or submultiple of 1, 2, or 5;

S.1.2.1. Weight Units. Except for postal scales, indicating and recording elements for shipping and postal applications, and scales used to print standard pack labels, a device shall indicate weight values using only a single unit of measure. (Amended 2004)

S.1.3. Provision for Sealing.

(a) **Automatic Weighing Systems, Except Automatic Checkweighers.** A device shall be designed with provision(s) as specified in Table S.1.3. "Categories of Device and Methods of Sealing," for applying a security seal that must be broken, or for using other approved means of providing security (e.g., data change audit trail available at the time of inspection), before any change that detrimentally affects the metrological integrity of the device can be made to any electronic mechanism.

Table S.1.3.
Categories of Device and Methods of Sealing

Categories of Device	Method of Sealing
Category 1: No remote configuration capability.	Seal by physical seal or two event counters: one for calibration parameters and one for configuration parameters.
Category 2: Remote configuration capability, but access is controlled by physical hardware. The device shall clearly indicate that it is in the remote configuration mode and record such message if capable of printing in this mode.	The hardware enabling access for remote communication must be at the device and sealed using a physical seal or two event counters: one for calibration parameters and one for configuration parameters.
Category 3: Remote configuration capability access may be unlimited or controlled through a software switch (e.g., password).	An event logger is required in the device; it must include an event counter (000 to 999), the parameter ID, the date and time of the change, and the new value of the parameter. A printed copy of the information must be available through the device or through another on-site device. The event logger shall have a capacity to retain records equal to ten times the number of sealable parameters in the device, but not more than 1000 records are required. (Note: Does not require 1000 changes to be stored for each parameter.)

(b) **For Automatic Checkweighers.** Security seals are not required in applications where it would prohibit an authorized user from having access to the calibration functions of a device.
(Amended 2004)

S.1.4. Automatic Calibration. A device may be fitted with an automatic or a semi-automatic calibration mechanism. This mechanism shall be incorporated inside the device. After sealing, neither the mechanism nor the calibration process shall facilitate fraud.

S.1.5. Adjustable Components. Adjustable components shall be held securely in adjustment and, except for a zero-load balance mechanism, shall be located within the housing of the element.
(Amended 2004)

S.2. Design of Zero and Tare Mechanisms.

S.2.1. Zero Load Adjustment.

S.2.1.1. Automatic Zero-Setting Mechanism (Zero-Tracking.) Except for automatic checkweighers, under normal operating conditions the maximum load that can be "rezeroed," when either placed on or removed from the platform all at once, shall be 1.0 scale division.
(Amended 2004)

S.2.1.2. Initial Zero-Setting Mechanism. Except for automatic checkweighers, an initial zero-setting mechanism shall not zero a load in excess of 20% of the maximum capacity of the automatic weighing system unless tests show that the scale meets all applicable tolerances for any amount of initial load compensated by this device within the specified range.

S.2.2. Tare. On any automatic weighing system, the value of the tare division shall be equal to the value of the division. The tare mechanism shall operate only in a backward direction (i.e., in a direction of under-registration) with respect to the zero-load balance condition of the automatic weighing system. A device designed to automatically clear any tare value shall also be designed to prevent the automatic clearing of tare until a complete transaction has been indicated.

Note: On a computing automatic weighing system, this requires the input of a unit price, the display of the unit price, and a computed positive total price at a readable equilibrium. Other devices require that a transaction or lot run be completed.
(Amended 2004)

S.3. Verification Scale Interval.

S.3.1. Multiple Range and Multi-Interval Automatic Weighing System. The value of "e" shall be equal to the value of "d."

S.3.2. Load Cell Verification Interval Value. The relationship of the value for the load cell verification scale interval, v_{min}, to the scale division, d, for a specific scale installation shall be:

$$v_{min} \leq \frac{d}{\sqrt{N}}$$

where N is the number of load cells in the scale.

Note: When the value of the scale division, d, differs from the verification scale division, e, for the scale, the value of e must be used in the formula above.

S.3.3. For automatic checkweighers, the value of "e" shall be specified by the manufacturer and may be larger than "d," but in no case can "e" be more than 10 times the value of "d."

S.4. Weight Indicators, Weight Displays, Reports, and Labels.

S.4.1. Additional Digits in Displays. Auxiliary digital displays that provide additional digits for use during performance evaluation may be included on automatic checkweighers. However, in cases where these indications are not valid for determining the actual weight of a package (e.g., only appropriate for use in statistical process control programs by users) they shall be clearly and distinctly differentiated from valid weight displays by indicating them to the user.
(Amended 2004)

For example, the additional digits may be differentiated by color, partially covered by placing crosshatch overlays on the display, or made visible only after the operator presses a button or turns a key to set the device in a mode which enables the additional digits.

S.4.2. Damping. An indicating element equipped with other than automatic recording elements shall be equipped with effective means to permit the recording of weight values only when the indication is stable within plus or minus one scale division. The values recorded shall be within applicable tolerances.
(Amended 2004)

S.4.3. Over Capacity Indication. An indicating or recording element shall not display nor record any values when the scale capacity is exceeded by nine scale divisions.
(Amended 2004)

S.4.4. Label Printer. A device that produces a printed ticket to be used as the label for a package shall print all values digitally and of such size, style of type, and color as to be clear and conspicuous on the label.
(Amended 2004)

S.4.4.1. Label Printing. If an automatic check-weigher prints a label containing weight information that will be used in a commercial transaction, it must conform to all of the requirements specified for weigh-labelers so that the printed ticket meets appropriate requirements.
(Amended 2004)

S.5. Accuracy Class.

S.5.1. Marking. Weigh-labelers and automatic check-weighers shall be Class III devices and shall be marked accordingly, except that a weigh-labeler marked Class IIIS may be used in package shipping applications.
(Amended 1997)

S.6. Parameters for Accuracy Classes. The number of divisions for device capacity is designated by the manufacturer and shall comply with parameters shown in Table S.6.

S.7. Marking Requirements. [See also G-S.1., G-S.4., G-S.6., G-S.7., G-U.2.1.1., and UR.3.3.]

S.7.1. Location of Marking Information. Automatic weighing systems which are not permanently attached to an indicating element, and for which the load-receiving element is the only part of the weighing/load-receiving element visible after installation, may have the marking information required in G-S.1. of the General Code and Table S.7.a. and S.7.b. of the Automatic Weighing System Code located in an area that is accessible only through the use of a tool; provided that the information is easily accessible (e.g., the information may appear on the junction box under an access plate). The identification information for these automatic weighing systems shall be located on the weighbridge (load-receiving element) near the point where the signal leaves the weighing element or beneath the nearest access cover.

S.7.2. Marking Required on Components of Automatic Weighing Systems. The following components of automatic weighing systems shall be marked as specified in Tables S.7.a. and S.7.b.:

(a) Main elements and components when not contained in a single enclosure for the entire automatic weighing system;

(b) Load cells for which Certificates of Conformance (CC) have been issued under the National Type Evaluation Program; and

(c) Other equipment necessary to a weighing system, but having no metrological effect on the weighing system.
(Amended 2004)

Table S-6. Parameters for Accuracy Classes

		Number of divisions (n)	
Class	Value of the verification division (e)	Minimum	Maximum
SI Units			
III	0.1 to 2 g inclusive	100	10 000
	equal to or greater than 5 g	500	10 000
INCH-POUND Units			
III	0.0002 lb to 0.005 lb, inclusive	100	10 000
	0.005 oz to 0.125 oz, inclusive	100	10 000
	equal to or greater than 0.01 lb	500	10 000
	equal to or greater than 0.25 oz	500	10 000
IIIS	greater than 0.01 lb	100	1000
	greater than 0.25 oz	100	1000
For Class III devices, the value of "e" is specified by the manufacturer as marked on the device; "d" shall not be smaller than 0.1 "e." "e" shall be differentiated from "d" by size, shape, or color.			

(Amended 1997 and 2004)

Table S.7.a. Marking Requirements						
Weighing Equipment To Be Marked With		Weighing, load-receiving, and indicating element in same housing	Indicating element not permanently attached to weighing and load-receiving element	Weighing and load-receiving element not permanently attached to indicating element	Load cell with CC (11)	Other equipment or device (10)
Manufacturer's ID	(1)	X	X	X	X	
Model Designation	(1)	X	X	X	X	
Serial Number and Prefix	(2)	X	X	X	X	
Certificate of Conformance Number	(16)	X	X	X	X	X(16)
Accuracy Class	(14)	X	X(8)	X	X	X
Nominal Capacity	(3)(15)	X	X	X		X
Value of Division, d	(3)	X	X			X(13)
Value of "e"	(4)	X	X			
Temperature Limits	(5)	X	X	X	X	
Special Application	(11)	X	X	X		
Maximum Number of Scale Divisions n_{max}	(6)		X(8)	X	X	
Minimum Verification Division (e_{min})				X		
"S" or "M"	(7)				X	
Direction of Loading	(12)				X	
Minimum Dead Load					X	
Maximum Capacity (Max)		X			X	
Minimum Capacity (Min)		X				
Safe Load Limit					X	
Load Cell Verification Interval (v_{min})					X	
Maximum Belt Speed (m/sec or m/min)		X		X		

Note: See Table S.7.b. for applicable notes.
(Amended 1999 and 2002)

Table S.7.b.
Notes for Table S.7.a.

1. Manufacturer's identification and model designation. (See G-S.1.)

2. Serial number and prefix. (See G-S.1.)

3. The nominal capacity and value of the automatic weighing system division shall be shown together (e.g., 50 000 x 5 kg, or 30 x 0.01 lb) adjacent to the weight display when the nominal capacity and value of the automatic weighing system division are not immediately apparent. Each division value or weight unit shall be marked on variable-division value or division-unit automatic weighing systems.

4. Required only if different from "d."

5. Required only on automatic weighing systems if the range is other than -10 °C to 40 °C (14 °F to 104 °F).

6. This value may be stated on load cells in units of 1000 (e.g., n: 10 is 10 000 divisions).

7. Denotes compliance for single or multiple load cell applications.

8. An indicating element not permanently attached to a weighing element shall be clearly and permanently marked with the accuracy Class III, and the maximum number of divisions, n_{max}.

9. Necessary to the weighing system but having no metrological effect, e.g., auxiliary remote display, keyboard, etc.

10. The markings may be either on the load cell or in an accompanying document; except that, if an accompanying document is provided, the serial number shall appear both on the load cell and in the document. The manufacturer's name or trademark, the model designation, and identifying symbol for the serial number shall also be marked both on the load cell and in any accompanying document.

11. An automatic weighing system designed for a special application rather than general use shall be conspicuously marked with suitable words visible to the operator and customer restricting its use to that application.

12. Required if the direction of loading the load cell is not obvious.

13. Serial number and prefix (See G-S.1) modules without "intelligence" on a modular system (e.g., printer, keyboard module, cash drawer, and secondary display in a point-of-sale system) are not required to have serial numbers.

14. The accuracy Class of a device shall be marked on the device with the appropriate designation.

15. The nominal capacity shall be conspicuously marked on any automatic-indicating or recording automatic weighing system so constructed that the capacity of the indicating or recording element, or elements, is not immediately apparent.

16. Required only if a CC has been issued for the equipment.

(Amended 2002)

N. Notes

N.1. Test Requirements for Automatic Weighing Systems.

N.1.1. Test Pucks and Packages.

(a) Test pucks and packages shall be:

(i) representative of the type, size, and weight ranges to be weighed on a device, and

(ii) stable while in motion, hence the length and width of a puck or package should be greater than its height.

(b) For type evaluation the manufacturer shall supply the test pucks or packages for each range of test loads.
(Amended 1997)

N.1.2. Accuracy of Test Pucks or Packages. The error in any test puck or package shall not exceed one-fourth (1/4) of the acceptance tolerance. If packages are used to conduct field tests on automatic weighing systems, the package weights shall be determined on a reference scale or balance with an inaccuracy that does not exceed one-fifth (1/5) of the smallest tolerance that can be applied to the device under test.

N.1.3. Verification (Testing) Standards. Field standard weights shall comply with requirements of NIST Handbook 105-1 (Class F) or the tolerances expressed in Fundamental Considerations, paragraph 3.2. (i.e., one-third of the smallest tolerance applied).
(Amended 2004)

N.1.4. Radio Frequency Interference (RFI) and Other Electromagnetic Interference Susceptibility, Field Evaluation. An RFI test shall be conducted at a given installation when the presence of RFI has been verified and characterized if those conditions are considered "usual and customary".
(Added 2004)

N.1.5. Tests Loads. A performance test shall consist of four separate test runs conducted at different test loads according to Table N.1.5.1
(Amended 2004)

Table N.1.5. Test Loads
At or near minimum capacity
At or near maximum capacity
At two (2) critical points between minimum and maximum capacity
Test may be conducted at other loads if the device is intended for use at other specific capacities

(Amended 2004)

N.1.6. Influence Factor Testing. Influence factor testing shall be conducted statically.
(Amended 2004).

N.2. Test Procedures – Weigh-Labelers. If the device is designed for use in a non-automatic weighing mode, it shall be tested in the non-automatic mode according to Handbook 44 Section 2.20 Scales Code..

Note: If the device is designed for only automatic weighing, it shall only be tested in the automatic weighing mode.
(Amended 2004)

N.2.1. Non-Automatic Tests.

N.2.1.1. Increasing-Load Test. The increasing-load test shall be conducted with the test loads approximately centered on the load-receiving element of the scale.

N.2.1.2. Decreasing-Load Test. The decreasing-load test shall be conducted with the test loads approximately centered on the load-receiving element of the scale.

N.2.1.3. Shift Test. To determine the effect of off-center loading, a test load equal to one-half (1/2) maximum capacity shall be placed in the center of each of the four points equidistant between the center and front, left, back and right edges of the load receiver.

N.2.1.4. Discrimination Test. A discrimination test shall be conducted with the weighing device in equilibrium at zero load and at maximum test load, and under controlled conditions in which environmental factors are reduced to the extent that they will not affect the results obtained. This test is conducted from just below the lower edge of the zone of uncertainty for increasing load tests, or from just above the upper edge of the zone of uncertainty for decreasing-load tests.

N.2.1.5. Zero-Load Balance Change. A zero-load balance change test shall be conducted on all automatic weighing systems after the removal of any test load. The zero-load balance should not change by more than the minimum tolerance applicable. (Also see G-UR.4.2.)
(Amended 2004)

N.2.2. Automatic Test Procedures.

N.2.2.1. Tests Non-Automatic. If the automatic weighing system is designed to operate non-automatically, and is used in that manner, during normal use operation, it shall be tested non-automatically using mass standards. The device shall not be tested non-automatically if it is used only in the automatic mode.

N.2.2.2. Automatic Tests. The device shall be tested at the normal operating speed using packages. Test runs should be conducted using at least two test loads distributed over its normal weighing range (e.g., near the lowest and highest ranges in which the device is typically operated). Each test load should be run a minimum of 10 consecutive times.
(Amended 2004)

N.3. Test Procedures - Automatic Checkweigher.

N.3.1. Tests Non-Automatic. If the scale is designed to operate non-automatically during normal user operation, it shall be tested non-automatically according to paragraphs N.2.1.1. Increasing Load Test thnrough N.2.1.5. Zero-Balance Change.

N.3.2. Automatic Tests. The device shall be tested at the highest speed in each weight range using standardized test pucks or packages. Test runs shall be conducted using two test loads. The number of consecutive test weighments shall be as specified in Table N.3.2.
(Amended 2004)

Table N.3.2. Number of Sample Weights Per Test for Automatic Checkweighers

Weighing Range m = mass of test load	Number of sample weights per test	
	Field	Type Evaluation
20 divisions $\leq$ m $\leq$ 10 kg 20 divisions $\leq$ m $\leq$ 22 lb	30	60
10 kg < m $\leq$ 25 kg 22 lb < m $\leq$ 55 lb	16	32
25 kg < m $\leq$ 100 kg 55 lb < m $\leq$ 220 lb	10	20
100 kg (220 lb) < m	10	10

(Amended 2004)

T. Tolerances

T.1. Principles.

T.1.1. Design. The tolerance for a weighing device is a performance requirement independent of the design principle used.

T.1.2. Scale Division. The tolerance for a weighing device is related to the value of the scale division (d) or the value of the verification scale division (e) and is generally expressed in terms of d or e. The random tolerance for automatic checkweighers is expressed in terms of Maximum Allowable Variance (MAV).

T.2. Tolerance Application.

T.2.1. General. The tolerance values are positive (+) and negative (-) with the weighing device adjusted to zero at no load. When tare is in use, the tolerance values are applied from the tare zero reference; the tolerance values apply to certified test loads only.

T.2.2. Type Evaluation Examinations. For type evaluation examinations, the tolerance values apply to increasing and decreasing load tests within the temperature, and power supply limits specified in T.7. Influence Factors.
(Amended 2004)

T.2.3. Multiple Range and Multi-Interval Automatic Weighing System. For multiple range and multi-interval devices, the tolerance values are based on the value of the scale division of the range in use.

T.3. Tolerance Values.

T.3.1. Tolerance Values - Class III Weigh-Labeler. (See T.3.2. for Class IIIS Weigh-Labelers.)

T.3.1.1. Non-Automatic Tests. Tolerance values shall be as specified in Table T.3., Class III - Tolerances in Divisions.
(Amended 2004)

T.3.1.2. Automatic Tests. Acceptance tolerance values shall be the same as maintenance tolerance values specified in Table T.3., Class III - Tolerances in Divisions.
(Amended 2004)

Table T.3. Class III – Tolerance in Divisions (e)		
Test Load in Divisions	Tolerance in Divisions	
Class III	Acceptance	Maintenance
0 – 500	± 0.5	± 1
201 – 2000	± 1	± 2
2001 – 4000	± 1.5	± 3
4001+	± 2.5	± 5

(Amended 2004)

T.3.2. Tolerance Values - Class IIIS Weigh-Labelers in Package Shipping Applications.
(Added 1997)

T.3.2.1. Non-Automatic Tests. - Tolerance values shall be as specified in Table T.3.2.1. Non-Automatic Tolerances for Class IIIS Weigh-Labelers.
(Amended 2004)

Table T.3.2.1. Non-Automatic Tolerances for Class IIIS Weigh-Labelers		
Test Load in Divisions	Tolerance in Divisions	
Class IIIS	Acceptance	Maintenance
0 – 50	± 0.5	± 1
51 – 200	± 1	± 2
201 – 1000	± 1.5	± 3

(Added 1997) (Amended 2004)

T.3.2.2. Automatic Tests. - Tolerance values specified in Table T.3.2.2. Dynamic Tolerances for Class IIIS Weigh-Labelers shall be applied.
(Amended 2004)

Table T.3.2.2. Automatic Tolerances for Class IIIS Weigh-Labelers		
Test Load in Divisions	Tolerance in Divisions	
Class IIIS	Acceptance	Maintenance
0 - 50	± 1.5	± 2
51 - 200	± 2	± 3
201 - 1000	± 2.5	± 4

(Added 1997) (Amended 2004)

T.3.3. Tolerance Values - Automatic Checkweighers.

T.3.3.1. Laboratory Tests for Automatic Checkweighers.

T.3.3.1.1. Non-Automatic Tests. The acceptance tolerance values specified in Table T.3., Class III - Tolerance in Divisions, shall be applied.
(Amended 2004)

T.3.3.1.2. Automatic Tests.

(a) The systematic error for each test run must be within the acceptance tolerances for the test load as specified in Table N.1.5.
(Amended 2004)

(b) The standard deviation of the results shall not exceed one-ninth (1/9) of the Maximum Allowable Variation (MAV) for specific package weights (3 standard deviations cannot exceed one-third (1/3) of the MAV value) as required in the latest maintenance tolerances are being applied to the device under test.
(Amended 2004)

(i) For U.S. Department of Agriculture (USDA) inspected meat and poultry products packaged at a plant subject to inspection by the USDA Food Safety and Inspection Service, use Handbook 133 Table 2-9, U.S. Department of Agriculture, Meat and Poultry, Groups and Lower Limits for Individual Packages, or

(ii) For all other packages with a labeled net quantity in terms of weight use Handbook 133 Table 2-5, Maximum Allowable Variations for Packages Labeled by Weight.

(iii) For all packages with a labeled net quantity in terms of liquid or dry volume use Handbook 133 Table 2-6, Maximum Allowable Variations for Packages Labeled by Liquid or Dry Volume.
(Amended 2004)

T.3.3.2. Field Tests for Automatic Checkweighers.

T.3.3.2.1. Non-Automatic Test Tolerances. The tolerance values shall be as specified in Table T.3., Class III - Tolerance in Divisions.
(Amended 2004)

T.3.3.2.2. Automatic Test Tolerances.

(a) The systematic error requirement is not applied in a field test.

(b) The standard deviation of the test results shall not exceed one-ninth (1/9) of the Maximum Allowable Variation (MAV) for specific package weights (3 standard deviations cannot exceed one-third (1/3) of the MAV value) as required in the latest Edition of NIST Handbook 133. This value does not change regardless of whether acceptance or maintenance tolerances are being applied to the device under test.
(Amended 2004)

(i) For U.S. Department of Agriculture (USDA) inspected meat and poultry products packaged at a plant subject to inspection by the USDA Food Safety and Inspection Service, use Handbook 133 Table 2-9, U.S. Department of Agriculture, Meat and Poultry, Groups and Lower Limits for Individual Packages, or

(ii) For all other packages with a labeled net quantity in terms of weight use Handbook 133 Table 2-5, Maximum Allowable Variations for Packages Labeled by Weight.

(iii) For all packages with a labeled net quantity in terms of liquid or dry volume use Handbook 133 Table 2-6. Maximum Allowable Variations for Packages Labeled by Liquid or Dry Volume.
(Amended 2004)

T.4. Agreement of Indications. In the case of a weighing system equipped with more than one indicating element or indicating element and recording element combination, the difference in the weight value indications of any load shall not be greater than the absolute value of the applicable tolerance for that load, and shall be within tolerance limits.

T.5. Repeatability. The results obtained from several weighings of the same load under reasonably constast test conditions shall agree within the absolute value of the maintenance tolerance for that load, and shall be within applicable tolerances.
(Amended 2004)

T.6. Discrimination. A test load equivalent to 1.4 d shall cause a change in the indicated or recorded value of at least 2.0 d. This requires the zone of uncertainty to be not greater than 0.3 d (see N.2.1.4.).
(Amended 2004)

T.7. Influence Factors. The following factors are applicable to tests conducted under controlled conditions only.

T.7.1. Temperature. Devices shall satisfy the tolerance requirements under the following temperature conditions:

T.7.1.1. If not specified in the operating instructions or if not marked on the device, the temperature limits shall be: -10 °C to 40 °C (14 °F to 104 °F)

T.7.1.2. If temperature limits are specified for the device, the range shall be at least 30 °C (54 °F).

T.7.1.3. Temperature Effect on Zero-Load Balance. The zero-load indication shall not vary by more than one division per 5 °C (9 °F) change in temperature.

T.7.1.4. Operating Temperature. The indicating or recording element shall not display nor record any usable values until the operating temperature necessary for accurate weighing and a stable zero balance condition have been attained.

T.7.2. Electric Power Supply.

T.7.2.1. Range of Voltages.

(a) Automatic weighing systems that operate using alternating current must perform within the conditions defined in paragraphs T.3. through T.6., inclusive, when tested over the range of -15% to +10% of the marked nominal line voltage(s) at 60 Hz, or the voltage range marked by the manufacturer at 60 Hz.

(b) Automatic weighing systems that operate using DC current must perform within the conditions defined in paragraphs T.3. through T.6., inclusive, when tested over the range from minimum operating voltage[4] to +20% of the voltage marked on the instrument (nominal voltage).

(c) Battery-operated electronic automatic weighing systems with external or plug-in power supply (AC or DC) shall either continue to function correctly or not indicate any weight values if the voltage is below the manufacturer's specified value, the latter being larger than or equal to the minimum operating voltage.[4]

Note: This requirement applies only to metrologically significant voltage supplies.
(Amended 2001 and 2004)

T.7.2.2. Power Interruption. A power interruption shall not cause an indicating or recording element to display or record any values outside the applicable tolerance limits.
(Amended 2004)

T.8. Radio Frequency Interference (RFI) and Other Electromagnetic Interference Susceptibility. The difference between the weight indication with the disturbance and the weight indication without the disturbance (see also N.1.4.) shall not exceed one scale division (d) or the equipment shall:
(Amended 2004)

(a) blank the indication, or

(b) provide an error message, or

(c) the indication shall be so completely unstable that it could not be interpreted, or transmitted into memory or to a recording element, as a correct measurement value.

[4] The minimum operating voltage is defined as the lowest possible operating voltage before the automatic weighing system no longer indicates nor records weight values.
(Added 2004)

UR. User Requirements

UR.1. Selection Requirements. Equipment shall be suitable for the service in which it is used with respect to elements of its design, including but not limited to, its capacity, number of scale divisions, value of the scale division or verification scale division, minimum capacity, and computing capability.

UR.1.1. General. Automatic Weighing Systems shall be designated by the manufacturer for that service.

UR.1.2. Value of the Indicated and Recorded Scale Division. The value of the division as recorded shall be the same as the division value indicated.

UR.2. Installation Requirements.

UR.2.1. Protection From Environmental Factors. The indicating elements, the lever system or load cells, and the load-receiving element of a permanently installed scale, and the indicating elements of a scale not intended to be permanently installed, shall be adequately protected from environmental factors such as wind, weather, and RFI that may adversely affect the operation or performance of the device.

UR.2.2. Foundation, Supports, and Clearance. The foundation and supports of any scale installed in a fixed location shall be such as to provide strength, rigidity, and permanence of all components, and clearance shall be provided around all live parts to the extent that no contacts may result when the load-receiving element is empty, nor throughout the weighing range of the scale.

UR.2.3. Entry and Departure From Weighing Area. The belt or other conveyance that introduces the weighed load to the weighing zone and that carries the weighed load away from the weighing zone shall be maintained per the manufactures recommendations.

UR.3. Use Requirements.

UR.3.1. Minimum Load. The minimum load shall be as specified by the manufacturer, but not less than 20 divisions since the use of a device to weigh light loads is likely to result in relatively large errors.

UR.3.1.1. Minimum Load for Class IIIS Weigh-Labelers. The minimum load shall be as specified by the manufacturer, but not less than 10 divisions since the use of a device to weigh light loads is likely to result in relatively large errors.
(Added 1997)

UR.3.2. Maximum Load. An automatic weighing system shall not be used to weigh a load of more than its maximum capacity.
(Amended 2004)

UR.3.3. Special Designs. An automatic weighing system designed and marked for a special application shall not be used for other than its intended purpose.

UR.3.4. Use of Manual Gross Weight Entries. Manual entries are permitted only when a device or system is generating labels for standard weight packages.

UR.4. Maintenance Requirements.

UR.4.1. Balance Condition. If an automatic weighing system is equipped with a zero-load display, the zero-load adjustment of an automatic weighing system shall be maintained so that the device indicates or records a zero balance condition.

UR.4.2. Level Condition. If an automatic weighing system is equipped with a level-condition indicator, the automatic weighing system shall be maintained in level.

UR.4.3. Automatic Weighing System Modification. The length or the width of the load-receiving element of an automatic weighing system shall not be increased beyond the manufacturer's design dimension, nor shall the capacity of an automatic weighing system be increased beyond its design capacity by replacing or modifying the original primary indicating or recording element with one of a higher capacity, except when the modification has been approved by competent engineering authority, preferably that of the engineering department of the manufacturer of the automatic weighing system, and by the weights and measures authority having jurisdiction over the automatic weighing system.

S.2.1.1. Vapor Elimination on Loading Rack Metering Systems.

(a) A loading rack metering system shall be equipped with a vapor or air eliminator or other automatic means to prevent the passage of vapor and air through the meter unless the system is designed or operationally controlled by a method, approved by the weights and measures jurisdiction having control over the device, such that air and/or vapor cannot enter the system.

(b) Vent lines from the air or vapor eliminator (if present) shall be made of metal tubing or other rigid material.

(Added 1994)

S.2.2. Provision for Sealing. - Adequate provision shall be made for an approved means of security (e.g., data change audit trail) or for physically applying a security seal in such a manner that requires the security seal to be broken before an adjustment can be made of:

(a) any measurement element, or

(b) any adjustable element for controlling delivery rate when such rate tends to affect the accuracy of deliveries.

When applicable, the adjusting mechanism shall be readily accessible for purposes of affixing a security seal.

Audit trails shall use the format set forth in Table S.2.2. [Nonretroactive as of January 1, 1995.]
(Amended 1991, 1993, 1995 and 2003)

Table S.2.2. Categories of Device and Methods of Sealing

Categories of Device	*Method of Sealing*
Category 1: No remote configuration capability.	*Seal by physical seal or two event counters: one for calibration parameters and one for configuration parameters.*
Category 2: Remote configuration capability, but access is controlled by physical hardware. *Device shall clearly indicate that it is in the remote configuration mode and record such message if capable of printing in this mode.* *[Category 2 applies only to devices manufactured prior to January 1, 2005. Devices with remote configuration capability manufactured after that date must meet the sealing requirements outlined in Category 3. Devices without remote configuration capability manufactured after that date will be required to meet the minimum criteria outlined in Category 1.]*	*[The hardware enabling access for remote communication must be on-site. The hardware must be sealed using a physical seal or an event counter for calibration parameters and an event counter for configuration parameters. The event counters may be located either at the individual measuring device or at the system controller; however, an adequate number of counters must be provided to monitor the calibration and configuration parameters of the individual devices at a location. If the counters are located in the system controller rather than at the individual device, means must be provided to generate a hard copy of the information through an on-site device.]** *[*Nonretroactive as of January 1, 1996]*
Category 3: Remote configuration capability access may be unlimited or controlled through a software switch (e.g., password). The device shall clearly indicate that it is in the remote configuration mode and record such message if capable of printing in this mode or shall not operate while in this mode. [Nonretroactive as of January 1, 2001] *Nonretroactive as of January 1, 2005, all devices with remote configuration capability must comply with the sealing requirement of Category 3.*	*An event logger is required in the device; it must include an event counter (000 to 999), the parameter ID, the date and time of the change, and the new value of the parameter. A printed copy of the information must be available through the device or through another on-site device. The event logger shall have a capacity to retain records equal to ten times the number of sealable parameters in the device, but not more than 1000 records are required. (Note: Does not require 1000 changes to be stored for each parameter.)*

[Nonretroactive as of January 1, 1995.] (Table added 1993) (Amended 1995, 1998, and 1999)

S.2.2.1. Multiple Measuring Elements With a Single Provision for Sealing. *– A change to the adjustment of any measuring element shall be individually identified.*
[Nonretroactive as of January 1, 2005]

Note: Examples of acceptable identification of a change to the adjustment of a measuring element include, but are not limited to:

(1) a broken, missing, or replaced physical seal on an individual measuring element;

(2) a change in a calibration factor for each measuring element;

(3) a display of the date or the number of days since the last calibration event for each measuring element; or

(4) a counter indicating the number of calibration events per measuring element

(Added 2004)

S.2.3. Directional Flow Valves. - Valves intended to prevent reversal of flow shall be automatic in operation.

S.2.4. Stop Mechanism.

S.2.4.1. Indication. - The delivery for which the device is set shall be conspicuously indicated.
(Amended 1983)

S.2.4.2. Stroke Limiting Elements. - Stops or other stroke limiting elements subject to direct pressure or impact shall be:

(a) made secure by positive, nonfrictional engagement of these elements; and

(b) adjustable to provide for deliveries within tolerances.

(Amended 1983)

S.2.4.3. Setting. - If two or more stops or other elements may be selectively brought into operation to permit predetermined quantities of deliveries,

(a) the position for the proper setting of each such element shall be accurately defined; and

(b) any inadvertent displacement from the proper setting shall be obstructed.

(Amended 1983)

S.2.5. Zero-Set-Back Interlock, Retail Motor-Fuel Devices. - A device shall be constructed so that:

(a) after a delivery cycle has been completed by moving the starting lever to any position that shuts off the device, an automatic interlock prevents a subsequent delivery until the indicating elements, and recording elements if the device is equipped and activated to record, have been returned to their zero positions;

(b) the discharge nozzle cannot be returned to its designed hanging position (that is, any position where the tip of the nozzle is placed in its designed receptacle and the lock can be inserted) until the starting lever is in its designed shut-off position and the zero-set-back interlock has been engaged; and

(c) in a system with more than one dispenser supplied by a single pump, an effective automatic control valve in each dispenser prevents product from being delivered until the indicating elements on that dispenser are in a correct zero position.

(Amended 1981 and 1985)

S.2.6. Temperature Determination and Wholesale Devices*. - For test purposes, means shall be provided to determine the temperature of the liquid either:*

(a) in the liquid chamber of the meter, or

(b) immediately adjacent to the meter in the meter inlet or discharge line.

[Nonretroactive as of January 1, 1985.]
(Added 1984) (Amended 1986)

S.2.7. Wholesale Devices Equipped with Automatic Temperature Compensators.

S.2.7.1. Automatic Temperature Compensation. A device may be equipped with an automatic means for adjusting the indication and registration of the measured volume of product to the volume at 15°C (60°F).

S.2.7.2. Provision for Deactivating. - On a device equipped with an automatic temperature-compensating mechanism that will indicate or record only in terms of gallons compensated to 15°C (60°F), provision shall be made for deactivating the automatic temperature-compensating mechanism so that the meter can indicate, and record if it is equipped to record, in terms of the uncompensated volume.
(Amended 1972)

S.2.7.3. Provision for Sealing Automatic Temperature Compensating Systems. - Provision shall be made for applying security seals in such a manner that an automatic temperature-compensating system cannot be disconnected and that no adjustment may be made to the system without breaking the seal.

S.2.7.4. Temperature Determination with Automatic Temperature Compensation. - For test purposes, means shall be provided (e.g., thermometer well) to determine the temperature of the liquid either:

(a) in the liquid chamber of the meter, or

(b) immediately adjacent to the meter in the meter inlet or discharge line.

(Amended 1987)

S.2.8. Exhaustion of Supply, Lubricant Devices Other Than Meter Types. - When the level of the supply of lubricant becomes so low as to compromise the accuracy of measurement, the device shall:

(a) become inoperable automatically, or

(b) give a conspicuous and distinct warning.

S.3. Discharge Lines and Valves.

S.3.1. Diversion of Measured Liquid. - No means shall be provided by which any measured liquid can be diverted from the measuring chamber of the meter or its discharge line. Two or more delivery outlets may be installed only if automatic means are provided to ensure that:

(a) liquid can flow from only one outlet at a time, and

(b) the direction of flow for which the mechanism may be set at any time is clearly and conspicuously indicated.

A manually controlled outlet that may be opened for purging or draining the measuring system or for recirculating product in suspension shall be permitted only when the system is measuring food products or agrichemicals. Effective means shall be provided to prevent passage of liquid through any such outlet during normal operation of the measuring system and to inhibit meter indications (or advancement of indications) and recorded representations while the outlet is in operation.
(Amended 1991, 1995, and 1996)

S.3.2. Exceptions. - The provisions of S.3.1. Diversion Prohibited shall not apply to truck refueling devices when diversion of flow to other than the receiving vehicle cannot readily be accomplished and is readily apparent. Allowable deterrents include, but are not limited to, physical barriers to adjacent driveways, visible valves, or lighting systems that indicate which outlets are in operation, and explanatory signs.
(Amended 1982, 1990, 1991 and 2002)

S.3.3. Pump-Discharge Unit. - A pump-discharge unit equipped with a flexible discharge hose shall be of the wet-hose type.

S.3.4. Gravity-Discharge Unit. - On a gravity-discharge unit:

(a) the discharge hose or equivalent pipe shall be of the dry-hose type with no shutoff valve at its outlet end unless the hose or pipe drains to the same level under all conditions of use;

(b) the dry hose shall be sufficiently stiff and only as long as necessary to facilitate drainage;

(c) an automatic vacuum breaker, or equivalent mechanism, shall be incorporated to prevent siphoning and to ensure rapid and complete drainage; and

(d) the inlet end of the hose or outlet pipe shall be high enough to ensure complete drainage.

S.3.5. Discharge Hose, Reinforcement. - A discharge hose shall be reinforced so that the performance of the device is not affected by the expansion or contraction of the hose.

S.3.6. Discharge Valve. - A discharge valve may be installed in the discharge line only if the device is of the wet-hose type. Any other shutoff valve on the discharge side of the meter shall be of the automatic or semi-automatic predetermined-stop type or shall be operable only:

(a) by means of a tool (but not a pin) entirely separate from the device, or

(b) by mutilation of a security seal with which the valve is sealed open.

S.3.7. Antidrain Means. - In a wet-hose pressure-type device, means shall be incorporated to prevent the drainage of the discharge hose.
(Amended 1990)

S.4. Marking Requirements.

S.4.1. Limitation on Use. - The limitations on its use shall be clearly and permanently marked on any device intended to measure accurately only:

(a) products having particular properties; or

(b) under specific installation or operating conditions; or

(c) when used in conjunction with specific accessory equipment.

S.4.2. Air Pressure. - If a device is operated by air pressure, the air pressure gauge shall show by special graduations or other means the maximum and minimum working pressures recommended by the manufacturer.

S.4.3. Wholesale Devices.

S.4.3.1. Discharge Rates. - A wholesale device shall be marked to show its designed maximum and minimum discharge rates. However, the minimum discharge rate shall not exceed 20 percent of the maximum discharge rate.

S.4.3.2. Temperature Compensation. - If a device is equipped with an automatic temperature compensator, the primary indicating elements, recording elements, and recorded representation shall be clearly and conspicuously marked to show that the volume delivered has been adjusted to the volume at 15 °C (60 °F).

S.4.4. Retail Devices.

S.4.4.1. Discharge Rates. *- On a retail device with a designed maximum discharge rate of 115 L (30 gal) per minute or greater, the maximum and minimum discharge rates shall be marked in accordance with S.4.4.2. The marked minimum discharge rate shall not exceed 20% of the marked maximum discharge rate.*
[Nonretroactive as of January 1, 1985.]
(Added 1984) (Amended 2002 and 2003)

Example: With a marked maximum discharge rate of 230 L/min (60 gpm), the marked minimum discharge rate shall be 45 L/min (12 gpm) or less (e.g., 40 L/min (10 gpm) is acceptable). A marked minimum discharge rate greater than 45 L/min (12 gpm) (e.g., 60 L/min [15 gpm]) is not acceptable.
(Added 2003)

S.4.4.2. Location of Marking Information; Retail Motor-Fuel Dispensers. *– The required marking information in the General Code, Paragraph G-S.1.Identification shall appear as follows:*

(a) within 60 cm (24 in) to 150 cm (60 in) from the base of the dispenser;

(b) either internally and/or externally provided the information is permament and easily read; and

(c) on a portion of the device that cannot be readily removed or interchanged (i.e., not on a service access panel).

Note: *The use of a dispenser key or tool to acess internal marking information is permitted for Retail Liquid Measuring Devices.*
[Nonretroactive as of January 1, 2003]
(Added 2002) (Amended 2004)

S.5. Totalizers for Retail Motor-Fuel Dispensers. - *Retail motor-fuel dispensers shall be equipped with a nonresettable totalizer for the quantity delivered through the metering device.*
[Nonretroactive as of January 1, 1995.]
(Added 1993) (Amended 1994 and 1997)

N. Notes

N.1. Test Liquid.

N.1.1. Type of Liquid. - The liquid used for testing a liquid-measuring device shall be the type the device is used to measure, or another liquid with the same general physical characteristics.

N.1.2. Labeling. - Following the completion of a successful examination of a wholesale device, the weights and measures official should attach a label or tag indicating the type of liquid used during the test.

N.2. Volume Change. - Care shall be taken to minimize changes in volume of the test liquid due to temperature changes and evaporation losses.

N.3. Test Drafts.

N.3.1. Retail Piston-Type and Visible-Type Devices. – Test drafts shall include the full capacity delivery and each intermediate delivery for which the device is designed.

N.3.2. Slow Flow Meters. - Test drafts shall be equal to at least four times the minimum volume that can be measured and indicated through either a visible indication or an audible signal.

N.3.3. Lubricant Devices. - Test drafts shall be 1 L (1 qt). Additional test drafts may include 0.5 L (1 pt), 4 L (4 qt), and 6 L (6 qt).

N.3.4. Other Retail Devices. - On devices with a designed maximum discharge rate of:

(a) less than 80 L (20 gal) per minute, tests shall include drafts of one or more amounts, including a draft of at least 19 liters (5 gal).

(b) 80 L (20 gal) per minute or greater, tests shall include drafts of one or more amounts, including a draft of at least the amount delivered by the device in one minute at the maximum flow rate of the installation.
(Amended 1984)

N.3.5. Wholesale Devices. - The delivered quantity should be equal to at least the amount delivered by the device in one minute at its maximum discharge rate, and shall in no case be less than 200 L (50 gal).
(Amended 1987 and 1996)

N.4. Testing Procedures.

N.4.1. Normal Tests. - The "normal" test of a device shall be made at the maximum discharge flow rate developed under the conditions of installation. Any additional tests conducted at flow rates down to and including one-half of the sum of the maximum discharge flow rate and the rated minimum discharge flow rate shall be considered normal tests.
(Amended 1991)

N.4.1.1. Wholesale Devices Equipped with Automatic Temperature-Compensating Systems.

[NOT ADOPTED]

N.4.1.2. Repeatability Tests. - Tests for repeatability should include a minimum of three consecutive test drafts of approximately the same size and be conducted under controlled conditions where variations in factors, such as temperature, pressure, and flow rate are reduced to the extent that they will not affect the results obtained.
(Added 2001)

4002.8. Liquid-Measuring Devices. (3.30.)

(a) Wholesale Devices Equipped With Automatic Temperature Compensating Systems. On wholesale devices equipped with automatic temperature compensating systems, normal tests:

(1) shall be conducted with the temperature compensating system connected and operating by comparing the compensated volume indicated or recorded to the actual delivered volume corrected to 60°F, and

(2) may be conducted with the temperature compensating system deactivated by comparing the uncompensated volume indicated or recorded to the actual delivered volume.

The first test shall be performed with the automatic temperature compensating system operating in the "as found" condition.

On devices that indicate or record both the compensated and uncompensated volume for each delivery, the tests in (1) and (2) may be performed as a single test.

N.4.2. Special Tests. - "Special" tests, to develop the operating characteristics of a liquid-measuring device and any special elements and accessories attached to or associated with the device, shall be made as circumstances require. Any test except as set forth in N.4.1. shall be considered a special test.

N.4.2.1. Slow-Flow Meters. - A "special" test shall be made at a flow rate:

(a) not larger than twice the actual minimum flow rate, and

(b) not smaller than the actual minimum flow rate of the installation.

N.4.2.2. Retail Motor-Fuel Devices.

(a) Devices with a flow-rate capacity less than 100 (25 gal) per minute shall have a "special" test performed at the slower of the following rates:

(1) 19 L (5 gal) per minute, or

(2) the minimum discharge rate marked on the device, or

(3) the minimum discharge rate at which the device will deliver when equipped with an automatic discharge nozzle set at its slowest setting.

(b) Devices marked with a flow-rate capacity 100 L (25 gal) or more per minute, shall have a "special" test performed at the slowest of the following rates:

(1) the minimum discharge rate marked on the device, or

(2) the minimum discharge rate at which the device will deliver when equipped with an automatic discharge nozzle set at its slowest setting.

(Added 1984)

N.4.2.3. Other Retail Devices. - "Special" tests of other retail devices shall be made at the slower of the following rates:

(a) 50 percent of the maximum discharge rate developed under the conditions of installation, or

(b) the minimum discharge rate marked on the device.

N.4.2.4. Wholesale Devices. - "Special" tests shall be made to develop the operating characteristics of a measuring system and any special associated or attached elements and accessories. "Special" tests shall include a test at the slower of the following rates:

(a) 20 percent of the marked maximum discharge rate; or

(b) the minimum discharge rate marked on the device.

N.4.3. Money-Value Computation Tests.

N.4.3.1. Laboratory Tests. - When testing the device in the laboratory:

(a) compliance with paragraph S.1.6.5., Money Value Computations, shall be determined by using the cone gear as a reference for the total quantity delivered;

(b) the indicated quantity shall agree with the cone gear representation with the index of the indicator within the width of the graduation; and

(c) the maximum allowable variation of the indicated sales price shall be as shown in Table 1. (Amended 1984)

N.4.3.2. Field Tests. - In the conduct of field tests to determine compliance with paragraph S.1.6.5., the maximum allowable variation in the indicated sales price shall be as shown in Table 1.
(Added 1982; Amended 1984)

N.5. Temperature Correction on Wholesale Devices. - Corrections shall be made for any changes in volume resulting from the differences in liquid temperatures between time of passage through the meter and time of volumetric determination in the prover. When adjustments are necessary, appropriate petroleum measurement tables should be used. (Amended 1974)

T. Tolerances

T.1. Application to Underregistration and to Overregistration. The tolerances hereinafter prescribed shall be applied to errors of underregistration and errors of overregistration, whether or not a device is equipped with an automatic temperature compensator.

T.2. Tolerance Values. - Maintenance, Acceptance, and Special Test Tolerances shall be as shown in Table T.2. (Amended 2002)

T.3. Repeatability. - When multiple tests are conducted at approximately the same flow rate and draft size, the range of the test results for the flow rate shall not exceed 40 percent of the absolute value of the maintenance tolerance and the results of each test shall be within the applicable tolerance. This tolerance does not apply to the test of the automatic temperature compensating system. See also N.4.1.2.
(Added 1992) (Amended 2001 and 2002)

T.4. Automatic Temperature Compensating Systems. - *The difference between the meter error (expressed as a percentage) for results determined with and without the automatic temperature compensating system activated shall not exceed:*

(a) 0.2 percent for mechanical automatic temperature compensating systems; and

(b) 0.1 percent for electronic automatic temperature compensating systems.

The delivered quantities for each test shall be approximately the same size. The results of each test shall be within the applicable acceptance or maintenance tolerance.
[Nonretroactive as of January 1, 1988.]

Table T.2. Accuracy Classes for Liquid Measuring Devices Covered in NIST Handbook 44 Section 3.30

Accuracy Class	Application	Acceptance Tolerance	Maintenance Tolerance	Special Test Tolerance
0.3	Petroleum products delivered from large capacity (flow rates over 115 L/min (30 gpm))** devices including motor fuel devices, heated products at or greater than 50 °C asphalt at or below temperatures 50 °C, all other liquids not shown where the typical delivery is over 200 L (50 gal).	0.2 %	0.3 %	0.5 %
0.3A	Asphalt at temperatures greater than 50 °C.	0.3 %	0.3 %	0.5 %
0.5*	Petroleum products delivered from small capacity (at 4 L/min (1 gpm) through 115 L/min (30 gpm))** motor fuel devices, agri-chemical liquids, and all other applications not shown where the typical delivery is $\leq$ 200 L (50 gal).	0.3 %	0.5 %	0.5 %
1.1	Petroleum products and other normal liquids from devices with flow rates** less than 1 gpm and devices designed to deliver less than one gallon.	0.75 %	1.0 %	1.25 %

* For 5-gallon and 10-gallon test drafts, the tolerances specified for Accuracy Class 0.5 in the table above do not apply. For these test drafts, the maintenance tolerances on normal and special tests for 5-gallon and 10-gallon test drafts are 6 cubic inches and 11 cubic inches, respectively. Acceptance tolerances on normal and special tests are 3 cubic inches and 5.5 cubic inches.

** Flow rate refers to designed or marked maximum flow rate.

(Added 2002) (Amended 2003 and 2004)

UR. User Requirements

UR.1. Selection Requirements.

UR.1.1. Discharge Hose.

UR.1.1.1. Length. - The length of the discharge hose on a retail motor-fuel device:

(a) shall be measured from its housing or outlet of the discharge line to the inlet of the discharge nozzle;

(b) shall be measured with the hose fully extended if it is coiled or otherwise retained or connected inside a housing; and

(c) shall not exceed 5.5 m (18 ft) unless it can be demonstrated that a longer hose is essential to permit deliveries to be made to receiving vehicles or vessels.

An unnecessarily remote location of a device shall not be accepted as justification for an abnormally long hose.
(Amended 1972 and 1987)

UR.1.1.2. Marinas and Airports.

UR.1.1.2.1. Length. - The length of the discharge hose shall be as short as practicable, and shall not exceed 15 m (50 ft) unless it can be demonstrated that a longer hose is essential.

UR.1.1.2.2. Protection. - Discharge hoses exceeding 8 m (26 ft) in length shall be adequately protected from weather and other environmental factors when not in use.
(Made retroactive 1974 and amended 1984)

UR.2. Installation Requirements.

UR.2.1. Manufacturer's Instructions. - A device shall be installed in accordance with the manufacturer's instructions, and the installation shall be sufficiently secure and rigid to maintain this condition.
(Added 1987)

UR.2.2. Discharge Rate. - A device shall be installed so that the actual maximum discharge rate will not exceed the rated maximum discharge rate. Automatic means for flow regulation shall be incorporated in the installation if necessary.

UR.2.3. Suction Head. - A piston-type device shall be installed so that the total effective suction head will not be great enough to cause vaporization of the liquid being dispensed under the highest temperature and lowest barometric pressure likely to occur.

UR.2.4. Diversion of Liquid Flow. - A motor-fuel device equipped with two delivery outlets used exclusively in the fueling of trucks shall be so installed that any diversion of flow to other than the receiving vehicle cannot be readily accomplished and is readily apparent. Allowable deterrents include, but are not limited to, physical barriers to adjacent driveways, visible valves, or lighting systems that indicate which outlets are in operation, and explanatory signs.
(Amended 1991)

UR.2.5. Product Storage Identification.

(a) The fill connection for any petroleum product storage tank or vessel supplying motor-fuel devices shall be permanently, plainly, and visibly marked as to product contained.

(b) When the fill connection device is marked by means of a color code, the color code key shall be conspicuously displayed at the place of business.
(Added 1975 and amended 1976)

UR.3. Use of Device.

UR.3.1. Return of Indicating and Recording Elements to Zero. - On any dispenser used in making retail deliveries, the primary indicating element, and recording element if so equipped, shall be returned to zero before each delivery.

Exceptions to this requirement are totalizers on key-lock-operated or other self-operated dispensers and the primary recording element if the device is equipped to record.

UR.3.2. Unit Price and Product Identity.

(a) The following information shall be conspicuously displayed or posted on the face of a retail dispenser used in direct sale:

(1) except for dispensers used exclusively for fleet sales, other price contract sales, and truck refueling (e.g., truck stop dispensers used only to refuel trucks), all of the unit prices at which the product is offered for sale; and

(2) in the case of a computing type or money-operated type, the unit price at which the dispenser is set to compute.

Provided that the dispenser complies with S.1.6.4.1., it is not necessary that all the unit prices for all grades, brands, blends, or mixtures be simultaneously displayed or posted.

(b) The following information shall be conspicuously displayed or posted on each side of a retail dispenser used in direct sale:

(1) the identity of the product in descriptive commercial terms, and

(2) the identity of the grade, brand, blend, or mixture that a multi-product dispenser is set to deliver.
(Amended 1972, 1983, 1987, 1989, 1992, and 1993)

UR.3.3. Computing Device.

(a) Any computing device used in an application where a product or grade is offered for sale at more than one unit price (excluding fleet sales and other price contract sales), shall be used only for sales for which the device computes and displays the sales price for the selected transaction.
[Became Retroactive 1999]
(Added 1989) (Amended 1992 and 2000)

(b) A truck stop dispenser used exclusively for refueling trucks is exempt from the requirements in (a) if all purchases of fuel are accompanied by a printed receipt of the transaction containing the applicable price per gallon, the total gallons delivered, and the total price of the sale.
(Added 1993)

(c) Unless a truck stop dispenser used exclusively for refueling trucks complies with S.1.6.4.1. (Display of Unit Price), the price posted on the dispenser and the price at which the dispenser is set to compute shall be the highest price for any transaction which may be conducted.
(Added 1993)

UR.3.4. Printed Ticket. - The total price, the total volume of the delivery, and the price per gallon or liter shall be shown, either printed or in clear hand script, on any printed ticket issued by a device and containing any one of these values.
(Amended 2001)

UR.3.5. Steps After Dispensing. - After delivery to a customer from a retail motor-fuel device:

(a) the starting lever shall be returned to its shutoff position and the zero-set-back interlock engaged; and

(b) the discharge nozzle shall be returned to its designed hanging position unless the primary indicating elements, and recording elements if the device is equipped and activated to record, have been returned to a definite zero indication.

UR.3.6. Temperature Compensation, Wholesale.

UR.3.6.1. Automatic.

UR.3.6.1.1. When to be Used. - If a device is equipped with a mechanical automatic temperature compensator, it shall be connected, operable, and in use at all times. An electronic or mechanical automatic temperature compensating system may not be removed, nor may a compensated device be replaced with an uncompensated device, without the written approval of the responsible weights and measures jurisdiction.

[Note: This requirement does not specify the method of sale for product measured through a meter.]
(Amended 1989)

UR.3.6.1.2. Invoices.

(a) A written invoice based on a reading of a device that is equipped with an automatic temperature compensator shall show that the volume delivered has been adjusted to the volume at 15 °C (60 °F).

(b) The invoice issued from an electronic wholesale device equipped with an automatic temperature compensating system shall also indicate: (1) the API gravity, specific gravity or coefficient of expansion for the product; (2) product temperature; and (3) gross reading.
(Amended 1987)

UR.3.6.2. Nonautomatic.

UR.3.6.2.1. Temperature Determination. - If the volume of the product delivered is adjusted to the volume at 15 °C (60 °F), the product temperature shall be taken during the delivery in:

(a) the liquid chamber of the meter, or

(b) the meter inlet or discharge line adjacent to the meter, or

(c) the compartment of the receiving vehicle at the time it is loaded.

UR.3.6.2.2. Invoices. - The accompanying invoice shall indicate that the volume of the product has been adjusted for temperature variations to a volume at 15 °C (60 °F) and shall also state the product temperature used in making the adjustment.

UR.3.6.3. Period of Use. – When fuel is bought or sold on an automatic or nonautomatic temperature-compensated basis, it shall be bought or sold using this method over at least a consecutive 12-month period, unless otherwise agreed to by both the buyer and seller in writing.
(Added 2003)

(14.696 lb/in^2 absolute). *When a compensator system malfunctions, the indicating and recording elements may indicate and record in uncompensated volume if the mode of operation is clearly indicated, e.g., by a marked annunciator, recorded statement, or other obvious means.**
*[*Nonretroactive as of January 1, 1992.]*
(Amended 1991 and 2002)

S.2.5. Provision for Sealing. - Adequate provision shall be made for applying security seals in such a manner that no adjustment or interchange may be made of:

(a) any measurement element,

(b) any adjustable element for controlling delivery rate when such rate tends to affect the accuracy of deliveries, and

(c) any automatic temperature or density compensating system.

Any adjusting mechanism shall be readily accessible for purposes of affixing a security seal.

S.3. Design of Discharge Lines and Discharge Line Valves.

S.3.1. Diversion of Measured Liquid. - No means shall be provided by which any measured liquid can be diverted from the measuring chamber of the device or the discharge line therefrom, except that a manually controlled outlet that may be opened for purging or draining the measuring system shall be permitted. Effective means shall be provided to prevent the passage of liquid through any such outlet during normal operation of the device and to indicate clearly and unmistakably when the valve controls are so set as to permit passage of liquid through such outlet.

S.3.2. Discharge Hose. - The discharge hose of a measuring system shall be of the completely draining dry-hose type.

S.4. Level Condition, On-Board Weighing Systems. - Provision shall be made for automatically inhibiting the delivery of a cryogenic liquid when the vehicle is out-of-level beyond the limit required for the performance to be within applicable tolerance.
(Added 1986)

S.5. Marking Requirements.

S.5.1. Limitation of Use. - If a measuring system is intended to measure accurately only liquids having particular properties, or to measure accurately only under specific installation or operating conditions, or to measure accurately only when used in conjunction with specific accessory equipment, these limitations shall be clearly and permanently marked on the device.

S.5.2. Discharge Rates. - A meter shall be marked to show its designed maximum and minimum discharge rates.

S.5.3. Temperature or Density Compensation. - Devices equipped with an automatic temperature or density compensator, shall be clearly and conspicuously marked on the primary indicating elements, recording elements, and recorded representations to show that the quantity delivered has been adjusted to the conditions specified in S.2.4.

N. Notes

N.1. Test Liquid. - A meter shall be tested with the liquid to be commercially measured except that, in a type evaluation examination, nitrogen may be used.

N.2. Vaporization and Volume Change. - Care shall be exercised to reduce to a minimum vaporization and volume changes. When testing by weight, the weigh tank and transfer systems shall be precooled to liquid temperature prior to the start of the test to avoid the venting of vapor from the vessel being weighed.

N.3. Test Drafts.

N.3.1. Gravimetric Test. - Weight test drafts shall be equal to at least the amount delivered by the device in two minutes at its maximum discharge rate, and shall in no case be less than 907 kg (2 000 lb).

N.3.2. Transfer Standard Test. - When comparing a meter with a calibrated transfer standard, the test draft shall be equal to at least the amount delivered by the device in two minutes at its maximum discharge rate, and shall in no case be less than 180 L (50 gal) or equivalent thereof. When testing uncompensated volumetric meters in a continuous recycle mode, appropriate corrections shall be applied if product conditions are abnormally affected by this test mode.
(Amended 1976)

N.4. Density. - Temperature and pressure of the metered test liquid shall be measured during the test for the determination of density or volume correction factors when applicable. For Liquid Density and Volume Correction Factors (with respect to temperature and pressure) the publications shown in Table N.4. shall apply:
(Amended 1986 and 2004)

Table N.4. Density or Volume Correction Factors	
Cryogenic Liquid	Publication
Argon	Tegeler, Ch., Span, R., Wagner, W. "A New Equation of State for Argon Covering the Fluid Region for Temperatures from the Melting Line to 700 K at Pressures up to 1000". *Mpa J. Phys. Chem. Ref. Data,* 28(3):779-850, 1999.
Ethylene	Smukala, J., Span, R. Wagner, W. "New Equation of State for Ethylene Covering the Fluid Region for Temperatures from the Melting Line to 450 K at Pressures up to 300 MPA." *J. Phys. Chem. Ref. Data,* 29(5):1053-1122, 2000.
Nitrogen	Span, R., Lemmon, E. W., Jacobsen, R.T., Wagner, W., and Yokozeki, A. "A Reference Thermodynamic Property Formulation for Nitrogen." *J. Phys. Chem. Ref. Data,* Volume 29, Number 6, pp. 1361-1433, 2000.
Oxygen	Schmidt, R., Wagner, W. "A New Form of the Equation of State for Pure Substances and its Application to Oxygen." *Fluid Phase Equilib.,* 19:175-200, 1985.
Hydrogen	"Thermophysical Properties of Fluids. 1. "Argon, Ethlene, Parahydrogen, Nitrogen, Nitrogen Trifluoride, and Oxygen," published in the *Journal of Physical and Chemical Reference Data,* Volume 11, 1982, Supplement No. 1, and published by the American Chemical Society and the American Institute of Physics for the National Institute of Standards and Technology.
Note: A complete database program containing all of the most recent equations for calculating density for various cryogenic liquids is available at www.nist.gov/srd/nist23.htm. There is a fee for download of this database.	

(Added 2004)

N.5. Testing Procedures.

N.5.1. Normal Tests. - The "normal" tests of a device shall be made over a range of discharge rates that may be anticipated under the conditions of installation.

N.5.1.1. Repeatability Tests. - Tests for repeatability should include a minimum of three consecutive test drafts of approximately the same size and be conducted under controlled conditions where variations in factors, such as, temperature pressure and flow rate are reduced to the extent that they will not affect the results obtained.
(Added 2001)

N.5.2. Special Tests. - Any test except as set forth in N.5.1. shall be considered a "special" test. Tests shall be conducted, if possible, to evaluate any special elements or accessories attached to or associated with the device. A device shall be tested at a minimum discharge rate of:

(a) 50 percent of the maximum discharge rate developed under the conditions of installation, or the minimum discharge rate marked on the device, whichever is less, or

(b) the lowest discharge rate practicable under conditions of installation.

Special tests may be conducted to develop any characteristics of the device that are not normally anticipated under the conditions of installation as circumstances require.

N.6. Temperature Correction. - Corrections shall be made for any changes in volume resulting from the differences in liquid temperature between time of passage through the meter and time of volumetric determination of test draft.

N.7. Automatic Temperature or Density Compensation. When a device is equipped with an automatic temperature or density compensator, the compensator shall be tested by comparing the quantity indicated or recorded by the device (with the compensator connected and operating) with the actual delivered quantity corrected to the normal boiling point of the cryogenic product being measured or to the normal temperature and pressure as applicable.

T. Tolerances

T.1. Application.

T.1.1. To Underregistration and to Overregistration. The tolerances hereinafter prescribed shall be applied to errors of underregistration and errors of overregistration.

Table T.2. Accuracy Classes and Tolerances for Cryogenic Liquid-Measuring Devices

Accuracy Class	Application	Acceptance Tolerance	Maintenance Tolerance	Special Test Tolerance
2.5	Cryogenic products; liquefied compressed gases other than liquid carbon dioxide	1.5%	2.5%	2.5%

(Added 2003)

T.2. Tolerance Values. – The maintenance and acceptance tolerances for normal and special tests shall be as shown in Table T.2.
(Amended 2003)

T.3. On Tests Using Transfer Standards. - To the basic tolerance values that would otherwise be applied, there shall be added an amount equal to two times the standard deviation of the applicable transfer standard when compared to a basic reference standard.
(Added 1976)

T.4. Repeatability. - When multiple tests are conducted at approximately the same flow rate and draft size, the range of the test results for the flow rate shall not exceed 40 percent of the absolute value of the maintenance tolerance and the results of each test shall be within the applicable tolerance. See also N.5.1.1.
(Added 2001)

UR. User Requirements

UR.1. Installation Requirements.

UR.1.1. Discharge Rate. - A device shall be so installed that the actual maximum discharge rate will not exceed the rated maximum discharge rate. If necessary, means for flow regulation shall be incorporated in the installation.

UR.1.2. Length of Discharge Hose. - The discharge hose shall be of such a length and design as to keep vaporization of the liquid to a minimum.

UR.1.3. Maintenance of Liquid State. - A device shall be so installed and operated that the product being measured shall remain in the liquid state during passage through the meter.

UR.2. Use Requirements.

UR.2.1. Return of Indicating and Recording Elements to Zero. - The primary indicating elements (visual) and the primary recording elements shall be returned to zero immediately before each delivery.

UR.2.2. Condition of Discharge System. - The discharge system, up to the measuring element, shall be pre-cooled to liquid temperatures before a "zero" condition is established prior to the start of a commercial delivery.

UR.2.3. Vapor Return Line. - A vapor return line shall not be used during a metered delivery.
(Amended 1976)

UR.2.4. Drainage of Discharge Line. - On a dry-hose system, upon completion of a delivery, the vendor shall leave the discharge line connected to the receiving container with the valve adjacent to the meter in the closed position and the valve at the discharge line outlet in the open position for a period of at least:

(a) 1 minute for small delivery devices, and

(b) 3 minutes for large delivery devices,

to allow vaporization of some product in the discharge line to force the remainder of the product in the line to flow into the receiving container.
(Amended 1976)

UR.2.5. Conversion Factors. - Established conversion values (see references in N.4.) shall be used whenever metered liquids are to be billed in terms of:

(a) kilograms or pounds based on a meter indication of liters, gallons, cubic meters of gas, or cubic feet of gas; or,

(b) cubic meters or cubic feet of gas based on a meter indication of liters or gallons, kilograms, or pounds; or,

(c) liters or gallons based on a meter indication of kilograms or pounds, cubic meters of gas or cubic feet of gas.

All sales of cryogenic liquids shall be based on either kilograms or pounds, liters or gallons at NBP[1], cubic meters of gas or cubic feet of gas at NTP[1].
(Amended 1986)

UR.2.6. Temperature or Density Compensation.

UR.2.6.1. Use of Automatic Temperature or Density Compensators. - If a device is equipped with an automatic temperature or density compensator, this shall be connected, operable, and in use at all times. Such automatic temperature or density compensator may not be removed, nor may a compensated device be replaced with an uncompensated device, without the written approval of the weights and measures authority having jurisdiction over the device.

UR.2.6.2. Tickets or Invoices. - Any written invoice or printed ticket based on a reading of a device that is equipped with an automatic temperature or density compensator shall have shown thereon that the quantity delivered has been adjusted to the quantity at the NBP of the specific cryogenic product or the equivalent volume of gas at NTP.

UR.2.6.3. Printed Ticket. - Any printed ticket issued by a device of the computing type on which there is printed the total computed price, the total quantity of the delivery, or the price per unit, shall also show the other two values (either printed or in clear script).

UR.2.6.4. Ticket in Printing Device. - A ticket shall not be inserted into a device equipped with a ticket printer until immediately before a delivery is begun, and in no case shall a ticket be in the device when the vehicle is in motion while on a public street, highway, or thoroughfare.

UR.2.7. Pressure of Tanks with Volumetric Metering Systems Without Temperature Compensation. - When the saturation pressure of the product in the vendor's tank exceeds 240 kPa (35 psia), a correction shall be applied to the written invoice or printed ticket using the appropriate tables as listed in N.4.; or the saturation pressure shall be reduced to 207 kPa (30 psia) (if this can be safely accomplished) prior to making a delivery.
(Added 1976)

[1] See Definitions section.

Section 5.58. Multiple Dimension Measuring Devices

The status of Section 5.58. Multiple Dimension Measuring Devices was changed from "tentative" to "permanent" effective January 1, 2005.

A. Application

A.1. General. This code applies to dimension and volume measuring devices used for determining the dimensions and/or volume of objects for the purpose of calculating freight, storage, or postal charges based on the dimensions and/or volume occupied by the object.

A.2. Insofar as they are clearly applicable, the provisions of this code apply also to devices designed to make multiple measurements automatically to determine a volume for other applications as defined by General Code paragraph G A.1.

A.3. In addition to the requirements of this code, multiple dimension measuring devices shall meet the requirements of Section 1.10. General Code.

A.4. This Code does not apply to:

(a) devices designed to indicate automatically (with or without value-computing capabilities) the length of fabric passed through the measuring elements (see Sec. 5.50. for Fabric-Measuring Devices);

(b) devices designed to indicate automatically the length of cordage, rope, wire, cable, or similar flexible material passed through the measuring elements (see Sec. 5.51. for Wire- and Cordage-Measuring Devices); or

(c) any linear measure, measure of length, or devices used to measure individual dimensions for the purpose of assessing a charge per unit of measurement of the individual dimension (see Sec. 5.52. for Linear Measures).

A.5. Type Evaluation. The National Type Evaluation Program will accept for type evaluation only those devices that comply with all requirements of this code.

S. Specifications

S.1. Design of Indicating and Recording Elements and of Recorded Representations.

S.1.1. Zero or Ready Indication.

(a) Provision shall be made to indicate or record either a zero or ready condition.

(b) A zero or ready condition may be indicated by other than a continuous digital zero indication, provided that an effective automatic means is provided to inhibit a measuring operation when the device is in an out-of-zero or non-ready condition.

S.1.2. Digital Indications. Indicated and recorded values shall be presented digitally.

S.1.3. Negative Values. Except when in the tare mode, negative values shall not be indicated or recorded.

S.1.4. Dimensions Indication. If in normal operation the device indicates or records only volume, a testing mode shall be provided to indicate dimensions for all objects measured.

S.1.5. Value of Dimension/Volume Division Units. The value of a device division "d" expressed in a unit of dimension shall be presented in a decimal format with the value of the division expressed as:

(a) 1, 2, or 5; or

(b) a decimal multiple or submultiple of 1, 2, or 5; or

(c) a binary submultiple of a specific inch-pound unit of measure.

Examples: device divisions may be 0.01, 0.02, 0.05; 0.1, 0.2, or 0.5; 1, 2, or 5; 10, 20, 50, or 100; 0.5, 0.25, 0.125, 0.0625, etc.

S.1.5.1. For Indirect Sales. In addition to the values specified in S.1.5., the value of the division may be 0.3 inch and 0.4 inch.

S.1.6. Customer Indications and Recorded Representations. Multiple dimension measuring devices or systems must provide information as specified in Table S.1.6. As a minimum, all devices or systems must be able to meet either Clumn 1 or Clumn II in Table S.1.6. (Amended 2004)

S.1.7. Minimum Lengths. The minimum length to be measured by a device is 12 divisions. The manufacturer may specify a longer minimum length.

S.1.8. Indications Below Minimum and Above Maximum. Except for entries of tare, when objects are smaller than the minimum dimensions identified in paragraph S.1.7. or larger than any of the maximum dimensions plus 9 d, and/or maximum volume marked on the device plus 9 d, or when a combination of dimensions for the object being measured exceeds the measurement capability of the device, the indicating or recording element shall either: (Amended 2004)

(a) not display or record any usable values, or

(b) identify the displayed or recorded representation with an error indication.

S.1.9. Operating Temperature. An indicating or recording element shall not display nor record any usable values until the operating temperature necessary for accurate measuring and a stable zero reference or ready condition have been attained.

S.1.10. Adjustable Components. Adjustable components shall be held securely in adjustment and, except for a zeroing mechanism (when applicable), shall be located within the housing of the element.

Tabls S.1.6. Required Information to be Provided by Multiple Dimension Measuring Systems

Information	Column I[1]	Column II[1]		Column III
	Provided by device	Provided by invoice or other means		Provided by invoice or other means as specified in contractual agreement
		Customer present	Customer not present	
1. Device identification[2]	D or P	P	P	P or A
2. Error message (when applicable)	D or P	P	N/A	N/A
3. Hexahedron* dimensions[3]	D or P	P	P	P or A
4. Hexahedron* volume (if used)[3]	D or P	P	P	P or A
5. Actual weight (if used)[3]	D or P	P	P	P or A
6. Tare (if used)[3]	D or P	N/A	N/A	N/A
7. Hexahedron* measurement statement[4]	D or P or M	P	P	P or G

A = AVAILABLE UPON REQUEST BY CUSTOMER[5]

B = DISPLAYED

G = PUBLISHED GUIDELINES OR CONTRACTS

M = MARKED

N/A = NOT APPLICABLE

P = PRINTED OR RECORDED IN A MEMORY DEVICE AND AVAILABLE UPON REQUEST BY CUSTOMER[5]

Notes:

1 As a minimum all devices or systems must be able to meet either Column I or Column II.

2 This is only required in systems where more than one device or measuring element is being used.

3 Some devices or systems may not utilize all of these values; however, as a minimum either hexahedron dimensions or hexahedron volume must be displayed or printed.

4 This is an explanation that the dimensions and/or volume shown are those of the smallest hexahedron in which the object that was measured may be enclosed rather than those of the object itself.

5 The information "available upon request by customer" shall be retained by the party having issued the invoice for at least 30 calendar days after the date of invoicing.

* Hexahedron = An object with six rectangular, plane surfaces (sides)

(Amended 2004)

S.1.11. Provision for Sealing.

(a) A device shall be designed with provision(s) for applying a security seal that must be broken, or for using other approved means of providing security (e.g., data change audit trail available at the time of inspection), before any change that detrimentally affects the metrological integrity of the device can be made to any measuring element.

(b) Audit trails shall use the format set forth in Table S.1.11.

S.2. Design of Zero and Tare.

S.2.1. Zero or Ready Adjustment. A device shall be equipped with means by which the zero reference or ready condition can be adjusted, or the zero reference or ready condition shall be automatically maintained. The zero reference or ready control circuits shall be interlocked so that their use is prohibited during measurement operations.

S.2.2. Tare. The tare function shall operate only in a backward direction (that is, in a direction of under-registration) with respect to the zero reference or ready condition of the device. The value of the tare division or increment shall be equal to the division of its respective axis on the device. There shall be a clear indication that tare has been taken.

S.3. Systems with Two or More Measuring Elements. A multiple dimension measuring system with a single indicating or recording element, or a combination indicating-recording element, that is coupled to two or more measuring elements with independent measuring systems, shall be provided with means to prohibit the activation of any measuring element (or elements) not in use, and shall be provided with automatic means to indicate clearly and definitely which measuring element is in use.

Note: This requirement does not apply to individual devices that use multiple emitters/sensors within a device in combination to measure objects in the same measurement field. (Amended 2004)

S.4. Marking Requirements. [See also G-S.1., G-S.4., G-S.5.2.5., G-S.6., G-S.7., G-UR.2.1.1., and G-UR.3.1.]

S.4.1. Multiple Dimension Measuring Devices, Main Elements, and Components of Measuring Devices. Multiple dimension measuring devices, main elements of multiple dimension measuring devices when not contained in a single enclosure for the entire dimension/volume measuring device, and other components shall be marked as specified in Table S.4.1.a. and explained in the accompanying notes, Table S.4.1.b.

S.4.2. Location of Marking Information. The required marking information shall be so located that it is readily observable without the necessity of the disassembly of a part requiring the use of any means separate from the device.

Table S.1.11. Categories of Devices and Methods of Sealing for Multiple Dimension Measuring Systems

Categories of Devices	Method of Sealing
Category 1: No remote configuration.	Seal by physical seal or two event counters: one for calibration parameters and one for configuration parameters.
Category 2: Remote configuration capability, but access is controlled by physical hardware. Device shall clearly indicate that it is in the remote configuration mode and record such message if capable of printing in this mode.	The hardware enabling access for remote communication must be at the device and sealed using a physical seal or two event counters: one for calibration parameters and one for configuration parameters.
Category 3. Remote configuration capability access may be unlimited or controlled through a software switch (e.g., password).	An event logger is required in the device; it must include an event counter (000 to 999), the parameter ID, the date and time of the change, and the new value of the parameter. A printed copy of the information must be available through the device or through another on-site device. The event logger shall have a capacity to retain records equal to ten times the number of sealable parameters in the device, but not more than 1000 records are required. (**Note**: Does not require 1000 changes to be stored for each parameter.)

5.58. Multiple Dimension Measuring Devices

Table S.4.1.a. Marking Requirements for Multiple Dimension Measuring Systems				
	Multiple Dimension Measuring Equipment			
To be Marked With	Multiple dimension measuring device and indicating element in same housing	Indicating element not permanently attached to multiple dimension measuring element	Multiple dimension measuring element not permanently attached to the indicating element	Other equipment (1)
Manufacturer's ID	X	X	X	X
Model Designation	X	X	X	X
Serial Number and Prefix	X	X	X	X (2)
Certificate of Conformance Number (8)	X	X	X	X (8)
Minimum and Maximum Dimensions for Each Side (3)	X	X	X	
Value of Measuring Division, d	X	X	X	
Temperature Limits (4)	X	X	X	
Minimum & Maximum Speed (5)	X	X	X	
Special Application (6)	X	X	X	
Limitation of Use (7)	X	X	X	

(Amended 2002)

Multiple Dimension Measuring Systems Table S.4.1.b.
Notes for Table S.4.1.a.

1. Necessary to the dimension and/or volume measuring system, but having no effect on the measuring value (e.g., auxiliary remote display, keyboard, etc.).

2. Modules without "intelligence" on a modular system (e.g. printer, keyboard module, etc.) are not required to have serial numbers.

3. The minimum and maximum dimensions (using upper or lower case type) can be shown as follows:

   Length: min _____ max _____
   Width : min _____ max _____
   Height: min _____ max _____

4. Required if the range is other than -10 °C to 40 °C (14 °F to 104 °F).

5. Multiple dimension measuring devices, which require that the object or device be moved relative to one another, shall be marked with the minimum and maximum speeds at which the device is capable of making measurements that are within the applicable tolerances shall be marked.

6. A device designed for a special application rather than general use shall be conspicuously marked with suitable words visible to the operator and the customer restricting its use to that application.

7. Materials, shapes, structures, combination of object dimensions, or object orientations that are inappropriate for the device or those that are appropriate.

8. Required only if a Certificate of Conformance has been issued for the equipment.

(Amended 2002 and 2004)

N. Notes

N.1. Test Procedures.

N.1.1. General. The device shall be tested using test standards and objects of known and stable dimensions.

N.1.2. Position Test. Measurements are made using different positions of the test object and consistent with the manufacturer's specified use for the device.

N.1.3. Disturbance Tests, Field Evaluation. A disturbance test shall be conducted at a given installation when the presence of disturbances specified in T.6. has been verified and characterized if those conditions are considered "usual and customary."
(Amended 2002)

N.1.4. Test Object Size. Test objects may vary in size from the smallest dimension to the largest dimension marked on the device, and for field verification examinations, shall be an integer multiple of "d."

N.1.4.1. Test Objects. Verification of devices may be conducted using appropriate test objects of various sizes and of stable dimensions. Test object dimensions must be known to an expanded uncertainty (coverage factor K = 2) of not more than one-third of the applicable device tolerance. The dimensions shall also be checked to the same uncertainty when used at the extreme values of the influence factors.

The dimension of all test objects shall be verified using a reference standard that is traceable to NIST (or equivalent national laboratory) and meet the tolerances expressed in NIST Handbook 44 Fundamental Considerations, paragraph 3.2 (i.e., one-third of the smallest tolerance applied to the device).
(Added 2004)

N.1.5. Digital Zero Stability. A zero indication change test shall be conducted on all devices which show a digital zero. After the removal of any test object, the zero indication shall not change. (Also see G-UR.4.2.)

T. Tolerances

T.1. Design. The tolerance for a multiple dimension measuring device is a performance requirement independent of the design principle used.

T.2. Tolerance Application.

T.2.1. Type Evaluation. For type evaluations, the tolerance values apply to tests within the influence factor limits of temperature and power supply voltage specified in T.5.1. and T.5.2.

T.2.2. Subsequent Verification. For subsequent verifications, the tolerance values apply regardless of the influence factors in effect at the time of the verification. (Also see G-N.2.)

T.2.3. Multi-interval (Variable Division-Value) Devices. For multi-interval devices, the tolerance values are based on the value of the device division of the range in use.

T.3. Tolerance Values. The maintenance and acceptance tolerance values shall be ± 1 division.
(Amended 2004)

T.4. Position Tests. For a test standard measured several times in different positions by the device all indications shall be within applicable tolerances.

T.5. Influence Factors. The following factors are applicable to tests conducted under controlled conditions only.

T.5.1. Temperature. Devices shall satisfy the tolerance requirements under the following temperature conditions.

T.5.1.1. Temperature Limits. If not marked on the device, the temperature limits shall be:

-10 °C to 40 °C (14 °F to 104 °F).

T.5.1.2. Minimum Temperature Range. If temperature limits are specified for the device, the range shall be at least 30 °C or 54 °F.

T.5.1.3. Temperature Effect on Zero Indication. The zero indication shall not vary by more than one division per 5 °C (9 °F) change in temperature.

T.5.2. Power Supply Voltage.

T.5.2.1. Alternating Current Power Supply. Devices that operate using alternating current must perform within the conditions defined in paragraphs T.3 through T.6., inclusive, from -15% to +10% of the marked nominal line voltage(s) at 60 Hz, or the voltage range marked by the manufacturer, at 60 Hz.
(Added 2004)

T.5.2.2. Direct Current Power Supply. Devices that operate using direct current shall operate and perform within the applicable tolerance at any voltage level at which the device is capable of displaying metrological registrations.
(Added 2004)

T.6. Disturbances, Field Evaluation. The following requirements apply to devices when subjected to disturbances which may normally exist in the surrounding environment. These disturbances include radio frequency interference (RFI), electromagnetic interference (EMI), acoustic changes, ambient light emissions, etc. The difference between the measurement indication with the disturbance and the measurement indication without the disturbance shall not exceed one division "d" or the equipment shall:

(a) blank the indication, or

(b) provide an error message, or

(c) the indication shall be so completely unstable that it could not be interpreted, or transmitted into memory or to a recording element, as a correct measurement value.

UR. User Requirements

UR.1. Selection Requirements. Equipment shall be suitable for the service in which it is used with respect to elements of its design, including but not limited to, its maximum capacity, value of the division, minimum capacity, and computing capability.

UR.1.1. Value of the Indicated and Recorded Division. The value of the division recorded shall be the same as the division value indicated.

UR.2. Installation Requirements.

UR.2.1. Supports. A device that is portable and is being used on a counter, table, or the floor shall be so positioned that it is firmly and securely supported.

UR.2.2. Foundation, Supports, and Clearance. The foundations and support of a device installed in a fixed location shall be such as to provide strength, rigidity, and permanence of all components, and clearance shall be provided around all live parts to the extent that no contacts may result when the measuring element is empty, nor throughout the performance range of the device such that the operation or performance of the device is adversely affected.

UR.2.3. Protection From Environmental Factors. The indicating and measuring elements of a device shall be adequately protected from environmental factors such as wind, weather, and RFI that may adversely affect the operation or performance of the device.

UR.3. Use Requirements.

UR.3.1. Minimum and Maximum Measuring Ranges. A device shall not be used to measure objects smaller than the minimum or larger than the maximum dimensions marked on the device.

UR.3.2. Special Designs. A multiple dimension measuring device designed and marked for a special application shall not be used for other than its intended purpose.

UR.4. Maintenance Requirements.

UR.4.1. Zero or Ready Condition. The zero-setting adjustment of a multiple dimension measuring device shall be maintained so that, with no object in or on the measuring element, the device shall indicate or record a zero or ready condition.

UR.4.2. Level Condition. If a multiple dimension measuring device is equipped with a level-condition indicator, the device shall be maintained in a level condition.

UR.4.3. Device Modification. The measuring capabilities of a device shall not be changed from the manufacturer's design unless the modification has been approved by the manufacturer and the weights and measures authority having jurisdiction over the device.

UR.5. Customer Information Provided. The user of a multiple dimension measuring device or system shall provide transaction information to the customer as specified in Table UR.5.
(Added 2004)

Table UR.5. Customer Information Provided			
Information	No Coantractual Agreement		Contractual Agreement
	Customer Present	Customer Not Present	
1. Object identification	N/A	P	P or A
2. Billing method (scale or dimensional weight if used)	D or P	P	P or A
3. Billing rate or rate chart	D or P or A	P or G or A	P or A
4. Dimensional weight (if used)	P	P	P or A
5. Conversion factor (if dimensional weight is used)	D or P or A	P	P or G
6. Dimensional weight statement[1] (if dimensional weight is used)	D or P	P	P or G
7. Total price	P	P	P or A

A = AVAILABLE UPON REQUEST BY CUSTOMER[2]

D = DISPLAYED

G = PUBLISHED GUIDELINES OR CONTRACTS

M = MARKED

N/A = NOT APPLICABLE

P = PRINTED

Notes:

[1] This is an explanation that the dimensional weight is not a true weight but is a calculated value obtained by applying a conversion factor to the hexahedron dimensions or volume of the object.

[2] The information "available upon request by customer" shall be retained by the party having issued the invoice for at least 30 calendar days after the date of invoicing.

Hexahedron = An object with six rectangular, plane surfaces (sides).

(Added 2004)

[THIS PAGE LEFT INTENTIONALLY BLANK]

Definitions

The specific code to which the definition applies is shown in [brackets] at the end of the definition. Definitions for the General Code [1.10] apply to all codes in Handbook 44.

A

absolute value. The absolute value of a number is the magnitude of that number without considering the positive or negative sign. [2.20]

acceptance test. The first official test of a farm milk tank, at a particular location, in which the tank is accepted as correct. This test applies to newly constructed tanks, relocated used tanks, and recalibrated tanks. [4.43]

accurate. A piece of equipment is "accurate" when its performance or value-that is, its indications, its deliveries, its recorded representations, or its capacity or actual value, etc., as determined by tests made with suitable standards-conforms to the standard within the applicable tolerances and other performance requirements. Equipment that fails so to conform is "inaccurate." (Also see "correct.") [1.10]

analog type. A system of indication or recording in which values are presented as a series of graduations in combination with an indicator, or in which the most sensitive element of an indicating system moves continuously during the operation of the device. [1.10]

animal scale. A scale designed for weighing single heads of livestock. [2.20]
(Amended 1987)

apparent mass versus 8.0 g/cm^3. The apparent mass of an object versus 8.0 g/cm^3 is the mass of material of density 8.0 g/cm^3 that produces exactly the same balance reading as the object when the comparison is made in air with a density of 1.2 mg/cm^3 at 20 °C. [3.30, 3.32]

approval seal. A label, tag, stamped or etched impression, or the like, indicating official approval of a device. (Also see "security seal.") [1.10]

atmospheric pressure. The average atmospheric pressure agreed to exist at the meter at various ranges of elevation, irrespective of variations in atmospheric pressure from time to time. [3.33]

audit trail. An electronic count and/or information record of the changes to the values of the calibration or configuration parameters of a device. [1.10, 2.20, 3.30]
(Added 1993)

automatic bulk weighing system. A weighing system adapted to the automatic weighing of bulk commodities in successive drafts of predetermined amounts, automatically recording the no-load and loaded weight values and accumulating the net weight of each draft. [2.22]

automatic checkweigher. An automatic weighing system that does not require the intervention of an operator during the weighing process and used to subdivide items of different weights into one or more subgroups, such as identifying packages that have acceptable or unacceptable fill levels according to the value of the difference between their weight and a pre-determined set point. These systems may be used to fill standard packages for compliance with net weight requirements. [2.24]
(Added 2004)

automatic gravimetric filling machine (instrument). A filling machine or instrument that fills containers or packages with predetermined and virtually constant mass of product from bulk by automatic weighing, and which comprises essentially an automatic feeding device or devices associated with one or more weighing unit and the appropriate discharge devices. [2.24]
(Added 2004)

automatic hopper scale. One adapted to the automatic weighing of bulk commodity in successive drafts of pre-determined amounts. (This is not an "automatic-indicating scale" defined below.) [2.20]

automatic-indicating scale. One on which the weights of applied loads of various magnitudes are automatically indicated throughout all or a portion of the weighing range of the scale. (A scale that automatically weighs out commodity in predetermined drafts, such as an automatic hopper scale, a packaging scale, and the like, is not an "automatic-indicating" scale.) [2.20]

automatic temperature or density compensation. The use of integrated or ancillary equipment to obtain from the output of a volumetric meter an equivalent mass, or an equivalent liquid volume at a normal temperature of 70 °F and absolute pressure of 14.696 lb/in^2 absolute. [3.34]

automatic weighing system (AWS). An automatic weighing system is a weighing device that, in combination with other hardware and/or software components, automatically weighs discrete items and that does not require the intervention of an operator during the weighing process. Examples include, but are not limited to, weigh-labelers and checkweighers. [2.24]
(Added 2004)

automatic zero-setting mechanism. Automatic means provided to maintain zero balance indication without the intervention of an operator. [2.20]

automatic zero-setting mechanism (belt-conveyor scale). A zero setting device that operates automatically without intervention of the operator after the belt has been running empty. [2.21]
(Added 2002)

auxiliary indicator. Any indicator other than the master weight totalizer that indicates the weight of material determined by the scale. [2.21]

axle-load scale. A scale permanently installed in a fixed location, having a load-receiving element specially adapted to determine the combined load of all wheels (1) on a single axle or (2) on a tandem axle of a highway vehicle. [2.20]

B

badge. A metal plate affixed to the meter by the manufacturer showing the manufacturer's name, serial number and model number of the meter, and its rated capacity. [3.33]

balance, zero-load. See "zero-load balance." [2.20]

balance indicator. A combination of elements, one or both of which will oscillate with respect to the other, for indicating the balance condition of a nonautomatic indicating scale. The combination may consist of two indicating edges, lines, or points, or a single edge, line, or point and a graduated scale. [2.20]

balancing mechanism. A mechanism (including a balance ball) that is designed for adjusting a scale to an accurate zero-load balance condition. [2.20]

base pressure. The absolute pressure used in defining the gas measurement unit to be used, and is the gauge pressure at the meter plus an agreed atmospheric pressure. [3.33]

basic time rate. The charge for time for all intervals except the initial interval. [5.54]

basic tolerances. Basic tolerances are those tolerances on underregistration and on overregistration, or in excess and in deficiency, that are established by a particular code for a particular device under all normal tests, whether maintenance or acceptance. Basic tolerances include minimum tolerance values when these are specified. Special tolerances, identified as such and pertaining to special tests, are not basic tolerances. [1.10]

basic distance rate. The charge for distance for all intervals except the initial interval. [5.54]

batching meter. A device used for the purpose of measuring quantities of water to be used in a batching operation. [3.36]

beam scale. One on which the weights of loads of various magnitudes are indicated solely by means of one or more weighbeam bars either alone or in combination with counterpoise weights. [2.20]

beam. See "weighbeam." [2.20]

bell prover. A calibrated cylindrical metal tank of the annular type with a scale thereon that, in the downward travel in a surrounding tank containing a sealing medium, displaces air through the meter being proved or calibrated. [3.33]

belt-conveyor. An endless moving belt for transporting material from place to place. [2.21]

belt-conveyor scale. A device that employs a weighing element in contact with a belt to sense the weight of the material being conveyed and the speed (travel) of the material, and integrates these values to produce total delivered weight. [2.21]

belt-conveyor scale systems area. The scale area refers to the scale suspension, weigh idlers attached to the scale suspension, 5 approach (-) idlers, and 5 retreat (+) idlers. [2.21]
(Added 2001)

bench scale. See "counter scale." [2.20]

billed weight. The weight used in the computation of the freight, postal, or storage change, whether actual weight or dimensional weight. [5.58]
(Added 2004)

binary submultiples. Fractional parts obtained by successively dividing by the number 2. Thus, one-half, one fourth, one-eighth, one-sixteenth, and so on, are binary submultiples. [1.10]

built-for-purpose device. Any main device or element which was manufactured with the intent that it be used as, or part of, a weighing or measuring device or system. [1.10]
(Added 2003)

C

calibration parameter. Any adjustable parameter that can affect measurement or performance accuracy and, due to its nature, needs to be updated on an ongoing basis to maintain device accuracy, e.g., span adjustments, linearization factors, and coarse zero adjustments. [2.20, 3.30]
(Added 1993)

car-wash timer. A timer used in conjunction with a coin-operated device to measure the time during which car-wash water, cleaning solutions, or waxing solutions are dispensed. [5.55]

center-reading tank. One so designed that the gauge rod or surface gauge, when properly positioned for use, will be approximately in the vertical axis of the tank, centrally positioned with respect to the tank walls. [4.43]

cereal grain and oil seeds. Agricultural commodities including, but not limited to, corn, wheat, oats, barley, flax, rice, sorghum, soybeans, peanuts, dry beans, safflower, sunflower, fescue seed, etc. [5.56]

chart recorder. See analog or digital recorder.
(Amended 2002)

check rate. A rate of flow usually 20 percent of the capacity rate. [3.33]

checkweighing scale. One used to verify predetermined weight within prescribed limits. [2.20]

class of grain. Hard Red Winter Wheat as distinguished from Hard Red Spring Wheat as distinguished from Soft Red Winter Wheat, etc. [5.56]

clear interval between graduations. The distance between adjacent edges of successive graduations in a series of graduations. If the graduations are "staggered," the interval shall be measured, if necessary, between a graduation and an extension of the adjacent graduation. (Also see "minimum clear interval.") [1.10]

cleared. A taximeter is "cleared" when it is inoperative with respect to all fare indication, when no indication of fare or extras is shown and when all parts are in those positions in which they are designed to be when the vehicle on which the taximeter is installed is not engaged by a passenger. [5.54]

cold-tire pressure. The pressure in a tire at ambient temperature. [5.53, 5.54]

computing type or computing type device. A device designed to indicate, in addition to weight or measure, the total money value of product weighed or measured, for one of a series of unit prices. [1.10]

computing scale. One that indicates the money values of amounts of commodity weighed, at predetermined unit prices, throughout all or part of the weighing range of the scale. [2.20]

concave curve. A change in the angle of inclination of a belt conveyor where the center of the curve is above the conveyor. [2.21]

concentrated load capacity (CLC) (also referred to as Dual Tandem Axle Capacity (DTAC). A capacity rating of a vehicle or axle-load scale, specified by the manufacturer, defining the maximum load applied by a group to two axles with a centerline spaced 4 feet apart and an axle width of 8 feet for which the weighbridge is designed. The concentrated load capacity rating is for both test and use. [2.20]
(Added 1988) (Amended 1991, 1994 and 2003)

configuration parameter. Any adjustable or selectable parameter for a device feature that can affect the accuracy of a transaction or can significantly increase the potential for fraudulent use of the device and, due to its nature, needs to be updated only during device installation or upon replacement of a component, e.g., division value (increment), sensor range, and units of measurement. [2.20, 3.30]
(Added 1993)

consecutive-car test train. A train consisting of cars weighed on a reference scale, then coupled consecutively and run over the coupled-in-motion railway track scale under test. [2.20]
(Added 1990)

construction-material hopper scale. A scale adapted to weighing construction materials such as sand, gravel, cement, and hot oil. [2.20]

contract sale. A sale where a written agreement exists, prior to the point of sale, in which both buyer and seller have accepted pricing conditions of the sale. Examples include, but are not limited to: e-commerce, club sales, or pre-purchase agreements. Any devices used in the determination of quantity must comply with NIST Handbook 44. [3.30, 3.31, 3.37]
(Added 1993) (Amended 2002)

conventional scale. If the use of conversion tables is necessary to obtain a moisture content value, the moisture meter indicating scale is called "conventional scale." The values indicated by the scale are dimensionless. [5.56]

conversion table. Any table, graph, slide rule, or other external device used to determine the moisture content from the value indicated by the moisture meter. [5.56]

correction table. Any table, graph, slide rule, or other external device used to determine the moisture content from the value indicated by the moisture meter when the indicated value is altered by a parameter not automatically corrected for in the moisture meter (for example, temperature or test weight). [5.56]

convex curve. A change in the angle of inclination of a belt conveyor where the center of the curve is below the conveyor. [2.21]

conveyor stringers. Support members for the conveyor on which the scale and idlers are mounted. [2.21]

correct. A piece of equipment is "correct" when, in addition to being accurate, it meets all applicable specification requirements. Equipment that fails to meet any of the requirements for correct equipment is "incorrect." (Also see "accurate.") [1.10]

counter scale. One that, by reason of its size, arrangement of parts, and moderate nominal capacity, is adapted for use on a counter or bench. Sometimes called "bench scale." [2.20]

counterbalance weight. One intended for application near the butt of a weighbeam for zero-load balancing purposes. [2.20]

counterpoise weight. A slotted or "hanger" weight intended for application near the tip of the weighbeam of a scale having a multiple greater than 1. [2.20]

coupled-in-motion railroad weighing system. A device and related installation characteristics consisting of (1) the associated approach trackage, (2) the scale (i.e., the weighing element, the load-receiving element, and the indicating element with its software), and (3) the exit trackage which permit the weighing of railroad cars coupled in motion. [2.20]
(Added 1992)

crane scale. One with a nominal capacity of 5000 pounds or more designed to weigh loads while they are suspended freely from an overhead, trackmounted crane. [2.20]

cryogenic liquid-measuring device. A system including a liquid-measuring element designed to measure and deliver cryogenic liquids in the liquid state. [3.34]
(Amended 1986 and 2003)

cryogenic liquids. Fluids whose normal boiling point is below 120 kelvin (-243 °F). [3.34]

cubic foot, standard. That quantity of gas that occupies a volume of one cubic foot when under a pressure of 14.73 lb/in^2 absolute and at a temperature of 60 °F. [3.33]

cubic foot, metered. That quantity of gas that occupies one cubic foot when under pressure and temperature conditions existing in the meter. [3.33]

cubic-foot bottle. A metal bottle open at the lower end and so supported that it may be easily raised or lowered in a tank that contains a sealing medium. With the level of the sealing medium properly adjusted, the bottle, when lowered, will displace exactly one cubic foot of air upon coming to rest on the bottom of the tank. The marks on the bottle defining the cubic foot are the bottom of the lower neck and the gauge mark that partially surrounds the gauge glass in the upper neck. [3.33]

cubic foot, gas. The amount of a cryogenic liquid in the gaseous state at a temperature of 70 °F and under a pressure of 14.696 lb/in^2 absolute that occupies one cubic foot. (See NTP.) [3.34]

D

"d", dimension division value. The smallest increment that the device displays for any axis and length of object in that axis. [5.58]
(Added 2004)

dairy-product-test scale. A scale used in determining the moisture content of butter and/or cheese or in determining the butterfat content of milk, cream, or butter. [2.20]

decreasing-load test. A test for automatic-indicating scales only, wherein the performance of the scale is tested as the load is reduced. [2.20]
(Amended 1987)

deficiency. See "excess and deficiency." [1.10]

digital type. A system of indication or recording of the selector type or one that advances intermittently in which all values are presented digitally, or in numbers. In a digital indicating or recording element, or in digital representation, there are no graduations. [1.10]

dimensional weight (or dim, weight). A value computed by dividing the object's volume by a conversion factor; it may be used for the calculation of charges when the value is greater than the actual weight. [5.58]
(Added 2004)

direct sale. A sale in which both parties in the transaction are present when the quantity is being determined. An unattended automated or customer-operated weighing or measuring system is considered to represent the device/business owner in transactions involving an unattended device. [1.10]
(Amended 1993)

discharge line. A rigid pipe connected to the outlet of a measuring device. [3.30]
(Added 1987)

discharge hose. A flexible hose connected to the discharge outlet of a measuring device or its discharge line. [3.30]
(Added 1987)

discrimination (of an automatic-indicating scale). The value of the test load on the load-receiving element of the scale that will produce a specified minimum change of the indicated or recorded value on the scale. [2.20]

dispenser. See motor-fuel device. [3.30]

distributed-car test train. A train consisting of cars weighed first on a reference scale, cars coupled consecutively in groups at different locations within the train, then run over the coupled-in-motion railway track scale under test. The groups are typically placed at the front, middle, and rear of the train. [2.20]
(Added 1990)

dry-hose type. A type of device in which it is intended that the discharge hose be completely drained following the mechanical operations involved in each delivery. (See "dry hose.") [3.30, 3.34]

dry hose. A discharge hose intended to be completely drained at the end of each delivery of product. (See "dry-hose type.") [3.30, 3.31]
(Amended 2002)

dynamic monorail weighing system. A weighing system which employs hardware or software to compensate for dynamic effects from the load or the system that do not exist in a static weighing, in order to provide a stable indication. Dynamic factors may include shock or impact loading, system vibrations, oscillations, etc., and can occur even when the load is not moving across the load receiving element. [2.20]
(Added 1999)

E

e_{min} (minimum verification scale division). The smallest scale division for which a weighing element complies with the applicable requirements. [2.20, 2.21, 2.24]
(Added 1997)

electronic link. An electronic connection between the weighing/load receiving or other sensing element and indicating element where one recognizes the other and neither can be replaced without calibration. [2.20]
(Added 2001)

element. A portion of a weighing or measuring device or system which performs a specific function and can be separated, evaluated separately, and is subject to specified full or partial error limits.
(Added 2002)

equal-arm scale. A scale having only a single lever with equal arms (that is, with a multiple of 1), equipped with two similar or dissimilar load-receiving elements (pan, plate, platter, scoop, or the like), one intended to receive material being weighed and the other intended to receive weights. There may or may not be a weighbeam. [2.20]

event counter. A nonresettable counter that increments once each time the mode that permits changes to sealable parameters is entered and one or more changes are made to sealable cali-bration or configuration parameters of a device. [2.20, 3.30]
(Added 1993)

event logger. A form of audit trail containing a series of records where each record contains the number from the event counter corresponding to the change to a sealable parameter, the identification of the parameter that was changed, the time and date when the parameter was changed, and the new value of the parameter. [2.20, 3.30]
(Added 1993)

excess and deficiency. When an instrument or device is of such a character that it has a value of its own that can be determined, its error is said to be "in excess" or "in deficiency," depending upon whether its actual value is, respectively, greater or less than its nominal value. (See "nominal.") Examples of instruments having errors "in excess" are: a linear measure that is too long; a liquid measure that is too large; and a weight that is "heavy." Examples of instruments having errors "in deficiency" are: a lubricating-oil bottle that is too small; a vehicle tank compartment that is too small; and a weight that is "light." [1.10]

extras. Charges to be paid by a passenger in addition to the fare, including any charge at a flat rate for the transportation of passengers in excess of a stated number and any charge for the transportation of baggage. [5.54]

F

face. That side of a taximeter on which passenger charges are indicated. [5.54]

face. That portion of a computing-type pump or dispenser which the actual computation of price per unit, delivered quantity, and total sale price. In the case of some electronic displays, this may not be an integral part of the pump or dispenser. [3.30]
(Added 1987)

fare. That portion of the charge for the hire of a vehicle that is automatically calculated by a taximeter through the operation of the distance and/or time mechanism. [5.54]

farm milk tank. A unit for measuring milk or other fluid dairy product, comprising a combination of (1) a stationary or portable tank, whether or not equipped with means for cooling its contents, (2) means for reading the level of liquid in the tank, such as a removable gauge rod or a surface gauge, and (3) a chart for converting level-of-liquid readings to volume; or such a unit in which readings are made on gauge rod or surface gauge directly in terms of volume. Each compartment of a subdivided tank shall, for purposes of this code, be construed to be a "farm milk tank." [4.43]

feeding mechanism. The means for depositing material to be weighed on the belt conveyor. [2.21]

fifth wheel. A commercially-available distance-measuring device which, after calibration, is recommended for use as a field transfer standard for testing the accuracy of taximeters and odometers on rented vehicles. [5.53, 5.54]

fifth-wheel test. A distance test similar to a road test, except that the distance traveled by the vehicle under test is determined by a mechanism known as a "fifth-wheel" that is attached to the vehicle and that independently measures and indicates the distance. [5.53, 5.54]

flag. A plate at the end of the lever arm or similar part by which the operating condition of a taximeter is controlled and indicated. [5.54]

fractional bar. A weighbeam bar of relatively small capacity for obtaining indications intermediate between notches or graduations on a main or tare bar. [2.20]

ft^3/h. Cubic feet per hour. [3.33]

G

gasoline gallon equivalent (GGE). Gasoline gallon equivalent (GGE) means 5.660 pounds of natural gas. [3.37] (Added 1994)

gasoline liter equivalent (GLE). Gasoline liter equivalent (GLE) means 0.678 kilograms of natural gas. [3.37] (Added 1994)

gauge pressure. The difference between the pressure at the meter and the atmospheric pressure (psi). [3.33]

gauge rod. A graduated, "dip-stick" type of measuring rod designed to be partially immersed in the liquid and to be read at the point where the liquid surface crosses the rod. [4.43]

gauging. The process of determining and assigning volumetric values to specific graduations on the gauge or gauge rod that serve as the basis for the tank volume chart. [4.43]

graduated interval. The distance from the center of one graduation to the center of the next graduation in a series of graduations. (Also see "value of minimum graduated interval.") [1.10]

graduation. A defining line, or one of the lines defining the subdivisions of a graduated series. The term includes such special forms as raised or indented or scored reference "lines" and special characters such as dots. (Also see "main graduation" and "subordinate graduation.") [1.10]

grain hopper scale. One adapted to the weighing of individual loads of varying amounts of grain. [2.20]

grain moisture meter. Any device indicating either directly or through conversion tables and/or correction tables the moisture content of cereal grains and oil seeds. Also termed "moisture meter." [5.56]

grain sample. That portion of grain or seed taken from a bulk of grain or seed to be bought or sold and used to determine the moisture content of the bulk. [5.56]

grain-test scale. A scale adapted to weighing grain samples used in determining moisture content, dockage, weight per unit volume, etc. [2.20, 5.56]

gravity discharge. A type of device designed for discharge by gravity. [3.30, 3.31 (Amended 2002)]

H

head pulley. The pulley at the discharge end of the belt conveyor. The power drive to drive the belt is generally applied to the head pulley. [2.21]

hired. A taximeter is "hired" when it is operative with respect to all applicable indications of fare or extras. The indications of fare include time and distance where applicable unless qualified by another indication of "Time Not Recording" or an equivalent expression. [5.54]

hopper scale. A scale designed for weighing bulk commodities whose load-receiving element is a tank, box, or hopper mounted on a weighing element. (Also, see "automatic hopper scale," "grain hopper scale," and "construction-material hopper scale.") [2.20]

I

idler space. The center-to-center distance between idler rollers measured parallel to the belt. [2.21]

idlers or idler rollers. Freely turning cylinders mounted on a frame to support the conveyor belt. For a flat belt, the idlers consist of one or more horizontal cylinders transverse to the direction of belt travel. For a troughed belt, the idlers consist of one or more horizontal cylinders and one or more cylinders at an angle to the horizontal to lift the sides of the belt to form a trough. [2.21]

in-service light indicator. A light used to indicate that a timing device is in operation. [5.55]

increasing-load test. The normal basic performance test for a scale in which observations are made as increments of test load are successively added to the load-receiving element of the scale. [2.20]

increment. The value of the smallest change in value that can be indicated or recorded by a digital device in normal operation. [1.10]

index of an indicator. The particular portion of an indicator that is directly utilized in making a reading. [1.10]

indicating element. An element incorporated in a weighing or measuring device by means of which its performance relative to quantity or money value is "read" from the device itself as, for example, an index-and-graduated-scale combination, a weighbeam-and-poise combination, a digital indicator, and the like. (Also see "primary indicating or recording element.") [1.10]

indicator, balance. See "balance indicator." [2.20]

initial zero-setting mechanism. Automatic means provided to set the indication to zero at the time the instrument is switched on and before it is ready for use. [2.20]
(Added 1990)

initial distance or time interval. The interval corresponding to the initial money drop. [5.54]

interval, graduated. See "graduated interval." [1.10]

interval, clear, between graduations. See "clear interval between graduations." [1.10]

J

jewelers' scale. One adapted to weighing gems and precious metals. [2.20]

K

kind of grain. Corn as distinguished from soybeans as distinguished from wheat, etc. [5.56]

L

label. A printed ticket, to be attached to a package, produced by a printer that is a part of a prepackaging scale or that is an auxiliary device. [2.20]

large-delivery device. Devices used primarily for single deliveries greater than 200 gallons, 2000 pounds, 20 000 cubic feet, 2 000 liters, or 2 000 kilograms. [3.34]

laundry-drier timer. A timer used in conjunction with a coin-operated device to measure the period of time that a laundry drier is in operation. [5.55]

liquefied petroleum gas vapor-measuring device. A system including a mechanism or device of the meter type, equipped with a totalizing index, designed to measure and deliver liquefied petroleum gas in the vapor state by definite volumes, and generally installed in a permanent location. The meters are similar in construction and operation to the conventional natural- and manufactured-gas meters. [3.32]

liquefied petroleum gas. A petroleum product composed predominantly of any of the following hydrocarbons or mixtures thereof: propane, propylene, butanes (normal butane or isobutane), and butylenes. [3.32, 3.33]

liquefied petroleum gas liquid-measuring device. A system including a mechanism or machine of the meter type designed to measure and deliver liquefied petroleum gas in the liquid state by a definite quantity, whether installed in a permanent location or mounted on a vehicle. Means may or may not be provided to indicate automatically, for one of a series of unit prices, the total money value of the liquid measured. [3.33]
(Amended 1987)

liquid volume correction factor. A correction factor used to adjust the liquid volume of a cryogenic product at the time of measurement to the liquid volume at NBP. [3.34]

liquid-fuel device. A device designed for the measurement and delivery of liquid fuels. [3.30]

liquid-measuring device. A mechanism or machine designed to measure and deliver liquid by definite volume. Means may or may not be provided to indicate automatically, for one of a series of unit prices, the total money value of the liquid measured, or to make deliveries corresponding to specific money values at a definite unit price. [3.30]

liquid fuel. Any liquid used for fuel purposes, that is, as a fuel, including motor fuel. [3.30]

livestock scale. A scale equipped with stock racks and gates and adapted to weighing livestock standing on the scale platform. [2.20]
(Amended 1989)

load-receiving element. That element of a scale that is designed to receive the load to be weighed; for example, platform, deck, rail, hopper, platter, plate, scoop. [2.20]

load cell. A device, whether electric, hydraulic, or pneumatic, that produces a signal proportional to the load applied. [2.20]

load cell verification interval (v). The load cell interval, expressed in units of mass, used in the test of the load cell for accuracy classification. [2.20, 2.21]
(Added 1996)

loading point. The location at which material to be conveyed is applied to the conveyor. [2.21]

low-flame test. A test simulating extremely low-flow rates such as caused by pilot lights. [3.33]

lubricant device. A device designed for the measurement and delivery of liquid lubricants, including, but not limited to, heavy gear lubricants and automatic transmission fluids (automotive). [3.30]

M

m^3/h. Cubic meters per hour. [3.33]

main-weighbeam elements. The combination of a main bar and its fractional bar, or a main bar alone if no fractional bar is associated with it. [2.20]

main bar. A principal weighbeam bar, usually of relatively large capacity as compared with other bars of the same weighbeam. (On an automatic-indicating scale equipped with a weighbeam, the main weighbeam bar is frequently called the "capacity bar.") [2.20]

main graduation. A graduation defining the primary or principal subdivisions of a graduated series. (Also see "graduation.") [1.10]

manual zero-setting mechanism. Nonautomatic means provided to attain a zero balance indication by the direct operation of a control. [2.20]

manufactured device. Any commercial weighing or measuring device shipped as new from the original equipment manufacturer. [1.10]
(Amended 2001)

mass flow meter. A device that measures the mass of a product flowing through the system. The mass measurement may be determined directly from the effects of mass on the sensing unit or may be inferred by measuring the properties of the product, such as the volume, density, temperature, or pressure, and displaying the quantity in mass units.
[3.30, 3.32]

master meter test method. A method of testing milk tanks that utilizes an approved master meter system for measuring test liquid removed from or introduced into the tank. [4.43]

master weight totalizer. An indicating element used with a belt conveyor scale to indicate the weight of material that was passed over the scale. The master weight totalizer is a primary indicating element of the belt-conveyor scale. [2.21]

material test. The test of a belt-conveyor scale using material (preferably that for which the device is normally used) that has been weighed to an accuracy of 0.1 percent. [2.21]
(Amended 1989)

maximum capacity. The largest load that may be accurately weighed. [2.24]
(Added 1999)

maximum cargo load. The maximum cargo load for trucks is the difference between the manufacturer's rated gross vehicle weight and the actual weight of the vehicle having no cargo load. [5.53]

measuring element. That portion of a complete multiple dimension measuring device that does not incude the indicating element. [5.58]
(Added 2004)

measurement field. A region of space or the measurement pattern produced by the measuring instrument in which objects are placed or passed through, either singly or in groups, when being measured by a single device. [5.58]
(Added 2004)

meter register. An observation index for the cumulative reading of the gas flow through the meter. In addition there are one or two proving circles in which one revolution of the test hand represents 1/2, 1, 2, 5, or 10 cubic feet, or 0.025, 0.05, 0.1, 0.2, or 0.25 cubic meter, depending on meter size. If two proving circles are present, the circle representing the smallest volume per revolution is referred to as the "leak-test circle." [3.33]

metrological integrity (of a device). The design, features, operation, installation, or use of a device that facilitates (1) the accuracy and validity of a measurement or transaction, (2) compliance of the device with weights and measures requirements, or (3) the suitability of the device for a given application. [1.10, 2.20]
(Added 1993)

minimum capacity. The smallest load that may be accurately weighed. The weighing results may be subject to excessive error if used below this value. [2.24]
(Added 1999)

minimum totalized load. The least amount of weight for which the scale is considered to be performing accurately. [2.21]

minimum tolerances. Minimum tolerances are the smallest tolerance values that can be applied to a scale. Minimum tolerances are determined on the basis of the value of the minimum graduated interval or the nominal or reading face capacity of the scale. (See also definition for basic tolerances.) [2.20]

minimum clear interval. The shortest distance between adjacent graduations when the graduations are not parallel. (Also see "clear interval.") [3.30]

minimum delivery. The least amount of weight that is to be delivered as a single weighment by a belt-conveyor scale system in normal use. [2.21]

moisture content (wet basis). The mass of water in a grain or seed sample (determined by the reference method) divided by the mass of the grain or seed sample expressed as a percentage (%). [5.56]

money-operated type. A device designed to be released for service by the insertion of money, or to be actuated by the insertion of money to make deliveries of product. [1.10]

money drop. An increment of fare indication. The "initial money drop" is the first increment of fare indication following activation of the taximeter. [5.54]

motor-fuel device or motor-fuel dispenser or retail motor- fuel device. A device designed for the measurement and delivery of liquids used as fuel for internal-combustion engines. The term "motor-fuel dispenser" means the same as "motor-fuel device"; the term "retail motor-fuel device" applies to a unique category of device (see definition of "retail device"). [3.30]

motor fuel. Liquid used as fuel for internal-combustion engines. [3.30]

multi-interval scale. A scale having one weighing range which is divided into partial weighing ranges, each with different scale intervals, with the weighing range determined automatically according to the load applied, both on increasing and decreasing loads. [2.20]
(Added 1995)

multi-jet water meter. A water meter in which the moving element takes the form of a multiblade rotor mounted on a vertical spindle within a cylindrical measuring chamber. The liquid enters the measuring chamber through several tangential orifices around the circumference and leaves the measuring chamber through another set of tangential orifices placed at a different level in the measuring chamber. These meters register by recording the revolutions of a rotor set in motion by the force of flowing water striking the blades. [3.36]
(Added 2003)

multi-revolution scale. An automatic-indicating scale having a nominal capacity that is a multiple of the reading-face capacity and that is achieved by more than one complete revolution of the indicator. [2.20]

multiple cell application load cell. A load cell intended for use in a weighing system which incorporates more than one load cell. A multiple cell application load cell is designated with the letter "M" or the term "Multiple." (See also "single cell application load cell.") [2.20]
(Added 1999)

multiple of a scale. In general, the multiplying power of the entire system of levers or other basic weighing elements. (On a beam scale, the multiple of the scale is the number of pounds on the load-receiving element that will be counterpoised by 1 pound applied to the tip pivot of the weighbeam.) [2.20]

multiple range scale. A scale having two or more weighing ranges with different maximum capacities and different scale intervals for the same load receptor, each range extending from zero to its maximum capacity. [2.20]
(Added 1995)

multiple-tariff taximeter. One that may be set to calculate fares at any one of two or more rates. [5.54]

multiple. An integral multiple; that is, a result obtained by multiplying by a whole number. (Also see "multiple of a scale.") [1.10]

N

natural gas. A gaseous fuel, composed primarily of methane, that is suitable for compression and dispensing into a fuel storage container(s) for use as an engine fuel. [3.37]
(Added 1994)

NBP. Normal boiling point of a cryogenic liquid at 14.696 lb/in^2 absolute. [3.34]

n_{max} (maximum number of scale divisions). The maximum number of scale divisions for which a main element or load cell complies with the applicable requirements. The maximum number of scale divisions permitted for an installation is limited to the lowest n_{max} marked on the scale indicating element, weighing element, or load cell. [2.20, 2.21, 2.24]
(Added 1997)

no-load reference value. A positive weight value indication with no load in the load-receiving element (hopper) of the scale. (Used with automatic bulk-weighing systems and certain single draft, manually-operated receiving hopper scales installed below grade and used to receive grain.) [2.20]

nominal. Refers to "intended" or "named" or "stated," as opposed to "actual." For example, the "nominal" value of something is the value that it is supposed or intended to have, the value that it is claimed or stated to have, or the value by which it is commonly known. Thus, "1-pound weight," "1-gallon measure," "1-yard indication," and "500-pound scale" are statements of nominal values; corresponding actual values may be greater or lesser. (See nominal capacity of a scale.) [1.10]

nominal capacity. The nominal capacity of a scale is (a) the largest weight indication that can be obtained by the use of all of the reading or recording elements in combination, including the amount represented by any removable weights furnished or ordinarily furnished with the scale, but excluding the amount represented by any extra removable weights not ordinarily furnished with the scale, and excluding also the capacity of any auxiliary weighing attachment not contemplated by the original design of the scale, and excluding any fractional bar with a capacity less than 2-1/2 percent of the sum of the capacities of the remaining reading elements, or (b) the capacity marked on the scale by the manufacturer, whichever is less. (Also see "nominal capacity, batching scale"; "nominal capacity, hopper scale.") [2.20]

nominal capacity, batching scale. The nominal capacity of a batching scale is the capacity as marked on the scale by the scale manufacturer, or the sum of the products of the volume of each of the individual hoppers, in terms of cubic feet, times the weight per cubic foot of the heaviest material weighed in each hopper, whichever is less. [2.20]

nominal capacity, hopper scale. The nominal capacity of a hopper scale is the capacity as marked on the scale by the scale manufacturer, or the product of the volume of the hopper in bushels or cubic feet times the maximum weight per bushel or cubic foot, as the case may be, of the commodity normally weighed, whichever is less. [2.20]

non-automatic checkweigher. A weighing instrument that requires the intervention of an operator during the weighing process, used to subdivide items of different weights into one or more subgroups, such as identifying packages that have acceptable or unacceptable fill levels according to the value of the difference between their weight and a pre-determined set point. [2.24]

> **Notes:** Determining the weighing result includes any intelligent action of the operator that affects the result, such as deciding and taking an action when an indication is stable or adjusting the weight of the weighed load.
>
> Deciding that the weighing result is acceptable means making a decision regarding the acceptance of each weighing result on observing the indication or releasing a print out. The weighing process allows the operator to take an action which influences the weighing result in the case where the weighing result is not acceptable.

(Added 2004)

non-automatic weighing system. A weighing instrument or system that requires the intervention of an operator during the weighing process to determine the weighing result or to decide that it is acceptable. [2.24]

> **Notes:** Determining the weighing result includes any intelligent action of the operator that affects the result, such as deciding and taking an action when an indication is stable or adjusting the weight of the weighed load.
>
> Deciding that the weighing result is acceptable means making a decision regarding the acceptance of each weighing result on observing the indication or releasing a print out. The weighing process allows the operator to take an action which influences the weighing result in the case where the weighing result is not acceptable.

(Added 2004)

nonretroactive. "Nonretroactive" requirements are enforceable after the effective date for:

1. devices manufactured within a State after the effective date;
2. both new and used devices brought into a State after the effective date; and
3. devices used in noncommercial applications which are placed into commercial use after the effective date.

Nonretroactive requirements are not enforceable with respect to devices that are in commercial service in the State as of the effective date or to new equipment in the stock of a manufacturer or a dealer in the State as of the effective date. *(Nonretroactive requirements are printed in italic type.)* [1.10]
(Amended 1989)

nose-iron. A slide-mounted, manually-adjustable pivot assembly for changing the multiple of a lever. [2.20]

notes. A section included in each of a number of codes, containing instructions, pertinent directives, and other specific information pertaining to the testing of devices. Notes are primarily directed to weights and measures officials. [1.10]

NTP density and volume correction factor. A correction factor used to adjust the liquid volume of a cryogenic product at the time of measurement to the gas equivalent at NTP. [3.34]

NTP. Normal temperature of 21 °C (70 °F) and pressure of 101.325 kPa (14.696 lb/in^2 absolute) respectively. [3.34]

O

odometer. A device that automatically indicates the total distance traveled by a vehicle. For the purpose of this code, this definition includes hub odometers, cable-driven odometers, and the distance-indicating or odometer portions of "speedometer" assemblies for automotive vehicles. [5.53]

official grain samples. Grain or seed used by the official as the official transfer standard from the reference standard method to test the accuracy and precision of grain moisture meters. [5.56]

official with statutory authority. The representative of the jurisdiction(s) responsible for certifying the accuracy of the device. [2.20, 2.21, 2.22]
(Added 1991)

operating tire pressure. The pressure in a tire immediately after a vehicle has been driven for at least 5 miles or 8 kilometers. [5.53, 5.54]

over-and-under indicator. An automatic-indicating element incorporated in or attached to a scale and comprising an indicator and a graduated scale with a central or intermediate "zero" graduation and a limited range of weight graduations on either side of the zero graduation, for indicating weights greater than and less than the predetermined values for which other elements of the scale may be set. (A scale having an over-and-under indicator is classed as an automatic-indicating scale.) [2.20]

overregistration and underregistration. When an instrument or device is of such a character that it indicates or records values as a result of its operation, its error is said to be in the direction of overregistration or underregistration, depending upon whether the indications are, respectively, greater or less than they should be. Examples of devices having errors of "overregistration" are: a fabric-measuring device that indicates more than the true length of material passed through it; and a liquid-measuring device that indicates more than the true amount of the liquid delivered by the device. Examples of devices having errors of "under-registration" are: a meter that indicates less than the true amount of product that it delivers; and a weighing scale that indicates or records less than the true weight of the applied load. [1.10]

P

parallax. The apparent displacement, or apparent difference in height or width, of a graduation or other object with respect to a fixed reference, as viewed from different points. [1.10]

parking meter. A coin-operated device for measuring parking time for vehicles. [5.55]

passenger vehicles. Vehicles such as automobiles, recreational vehicles, limousines, ambulances, and hearses. [5.53]

performance requirements. Performance requirements include all tolerance requirements and, in the case of nonautomatic-indicating scales, sensitivity requirements (SR). (See definitions for "tolerance" and "sensitivity requirement".) [1.10]

point-of-sale system. An assembly of elements including a weighing or measuring element, an indicating element, and a recording element (and may also be equipped with a "scanner") used to complete a direct sales transaction.
[2.20, 3.30, 3.32, 3.37]
(Added 1986) (Amended 1997)

poise. A movable weight mounted upon or suspended from a weighbeam bar and used in combination with graduations, and frequently with notches, on the bar to indicate weight values. (A suspended poise is commonly called a "hanging poise".) [2.20]

postal scale. A scale (usually a computing scale) designed for use to determine shipping weight or delivery charges for letters or parcels delivered by the U.S. Postal Service or private shipping companies. A weight classifier may be used as a postal scale. [2.20]
(Added 1987)

prepackaging scale. A computing scale specially designed for putting up packages of random weights in advance of sale. [2.20]

prescription scale. A scale or balance adapted to weighing the ingredients of medicinal and other formulas prescribed by physicians and others and used or intended to be used in the ordinary trade of pharmacists. [2.20]

pressure type (device). A type of device designed for operation with the liquid under artificially produced pressure. [3.30]

primary indicating or recording elements. The term "primary" is applied to those principal indicating (visual) elements and recording elements that are designed to, or may, be used by the operator in the normal commercial use of a device. The term "primary" is applied to any element or elements that may be the determining factor in arriving at the sale representation when the device is used commercially. (Examples of primary elements are the visual indicators for meters or scales not equipped with ticket printers or other

recording elements and both the visual indicators and the ticket printers or other recording elements for meters or scales so equipped.) The term "primary" is not applied to such auxiliary elements as, for example, the totalizing register or predetermined-stop mechanism on a meter or the means for producing a running record of successive weighing operations, these elements being supplementary to those that are the determining factors in sales representations of individual deliveries or weights. (See "indicating element" and "recording element".) [1.10]

prover oil. A light oil of low vapor pressure used as a sealing medium in bell provers, cubic-foot bottles, and portable cubic-foot standards. [3.33]

proving indicator. The test hand or pointer of the proving or leak-test circle on the meter register or index. [3.33]

prover method. A method of testing milk tanks that utilizes approved volumetric prover(s) for measuring the test liquid removed from or introduced into the tank. [4.43]
(Amended 2002)

R

"r" factor. A computation for determining the suitability of a vehicle scale for weighing vehicles with varying axle configurations. The factor was derived by dividing the weights in FHWA Federal Highway Bridge Gross Weight Table B by 34 000 lbs. (The resultant factors contained in Table UR.3.2.1.) [2.20]
(Added 1997)

radio frequency interference (RFI). Radio frequency interference is a type of electrical disturbance that, when introduced into electronic and electrical circuits, may cause deviations from the normally expected performance. [1.10]

random error(s). The sample standard deviation of the error (indicated values) for a number of consecutive automatic weighings of a load, or loads, passed over the load receptor, shall be expressed mathematically as: [2.24]

$$s = \sqrt{\frac{1}{n-1} \Sigma (x_i - \bar{x})^2}$$

or

$$s = \sqrt{\frac{1}{n-1} \left(\Sigma x_i^2 - \frac{(\Sigma x_i)^2}{n} \right)}$$

where:

x = error of a load indication
n = the number of loads
(Added 2004)

ranges, weight. See "weight ranges." [2.20]

rated scale capacity. That value representing the weight that can be delivered by the device in one hour. [2.21]

rated capacity. The rate of flow in cubic meters per hour of a hydrocarbon gas vapor-measuring device as recommended by the manufacturer. This rate of flow should cause a pressure drop across the meter not exceeding 1/2-inch water column. [3.33]

ratio test. A test to determine the accuracy with which the actual multiple of a scale agrees with its designed multiple. This test is used for scales employing counterpoise weights and is made with standard test weights substituted in all cases for the weights commercially used on the scale. (It is appropriate to use this test for some scales not employing counterpoise weights.) [2.20]

reading-face capacity. The largest value that may be indicated on the reading face, exclusive of the application or addition of any supplemental or accessory elements. [1.10]

reading face. That portion of an automatic-indicating weighing or measuring device that gives a visible indication of the quantity weighed or measured. A reading face may include an indicator and a series of graduations or may present values digitally, and may also provide money-value indications. [1.10]

recorded representation. The printed, embossed, or other representation that is recorded as a quantity by a weighing or measuring device. [1.10]

recording element. An element incorporated in a weighing or measuring device by means of which its performance relative to quantity or money value is permanently recorded on a tape, ticket, card, or the like, in the form of a printed, stamped, punched, or perforated representation. [1.10, 2.21]

recording scale. One on which the weights of applied loads may be permanently recorded on a tape, ticket, card, or the like in the form of a printed, stamped, punched, or perforated representation. [2.20]

reference weight car. A railroad car weighed on a scale for temporary use as a mass standard over a short period of time (typically, the time required to test one scale) as part of a test train.

Note: A test weight car that is representative of the types of cars typically weighed on the scale under test may be used wherever reference weight cars are specified. [2.20]
(Added 1991)

remanufactured device.

[NOT ADOPTED]

remanufactured element.

[NOT ADOPTED]

remote configuration capability. The ability to adjust a weighing or measuring device or change its sealable parameters from or through some other device that is not itself necessary to the operation of the weighing or measuring device or is not a permanent part of that device. [2.20, 3.30]
(Added 1993)

repaired devices.

[NOT ADOPTED]

repaired element.

[NOT ADOPTED]

retail device. A measuring device primarily used to measure product for the purpose of sale to the end user. [3.30, 3.32, 3.37]
(Amended 1987 and 2004)

retroactive. "Retroactive" requirements are enforceable with respect to all equipment. Retroactive requirements are printed herein in upright Roman type. (Also see "nonretroactive.") [1.10]

road test. A distance test, over a measured course, of a complete taximeter assembly when installed on a vehicle, the mechanism being actuated as a result of vehicle travel. [5.53]

rolling circumference. The rolling circumference is the straight line distance traveled per revolution of the wheel (or wheels) that actuates the taximeter or odometer. If more than one wheel actuates the taximeter or odometer, the rolling circumference is the average distance traveled per revolution of the actuating wheels. [5.53, 5.54]

S

scale division, number of (n). Quotient of the capacity divided by the value of the verification scale division: [2.20]

$$n = \frac{\text{Capacity}}{e}$$

scale division, value of (d). The value of the scale division, expressed in units of mass, is the smallest subdivision of the scale for analog indication or the difference between two consecutively indicated or printed values for digital indication or printing. (Also see "verification scale division".) [2.20]

scale section. A part of a vehicle, axle-load, livestock, or railway track scale consisting of two main load supports, usually transverse to the direction in which the load is applied. [2.20]

scale. See specific type of scale. [2.20]

seal. See "approval seal," "security seal". [1.10]

section capacity. The section capacity of a scale is the maximum live load that may be divided equally on the load pivots or load cells of a section.
(Added 2001)

section test. A shift test in which the test load is applied over individual sections of the scale. This test is conducted to disclose the weighing performance of individual sections, since scale capacity test loads are not always available and loads weighed are not always distributed evenly over all main load supports. [2.20]

security means. A method used to prevent access by other than qualified personnel, or to indicate that access has been made to certain parts of a scale that affect the performance of the device. [2.21]

security seal. A uniquely identifiable physical seal, such as a lead-and-wire seal or other type of locking seal, a pressure-sensitive seal sufficiently permanent to reveal its removal, or similar apparatus attached to a weighing or measuring device for protection against or indication of access to adjustment. (Also see "approval seal".) [1.10]
(Amended 1994)

selector-type. A system of indication or recording in which the mechanism selects, by means of a ratchet-and-pawl combination or by other means, one or the other of any two successive values that can be indicated or recorded. [1.10]

semi-automatic zero-setting mechanism. Automatic means provided to attain a direct zero balance indication requiring a single initiation by an operator. [2.20]

sensitivity requirement (SR). A performance requirement for a nonautomatic-indicating scale; specifically, the minimum change in the position of rest of the indicating element or elements of the scale in response to the increase or decrease, by a specified amount, of the test load on the load-receiving element of the scale. [2.20]

sensitivity (of a nonautomatic-indicating scale). The value of the test load on the load-receiving element of the scale that will produce a specified minimum change in the position of rest of the indicating element or elements of the scale. [2.20]

shift test. A test intended to disclose the weighing performance of a scale under off-center loading. [2.20]

side. That portion of a pump or dispenser which faces the consumer during the normal delivery of product. [3.30]
(Added 1987)

simulated-road test. A distance test during which the taximeter or odometer may be actuated by some means other than road travel. The distance traveled is either measured by a properly calibrated roller device or computed from rolling circumference and wheel-turn data. [5.53, 5.54]

simulated test. A test using artificial means of loading the scale to determine the performance of a belt-conveyor scale. [2.21]

single cell application load cell. A load cell intended for use in a weighing system which incorporates one or more load cells. A single cell application load cell is designated with the letter "S" or the term "Single." (See also "multiple cell application load cell.") [2.20]
(Added 1999)

single-tariff taximeter. One that calculates fares at a single rate only. [5.54]

skirting. Stationary side boards or sections of belt conveyor attached to the conveyor support frame or other stationary support to prevent the bulk material from falling off the side of the belt. [2.21]

slow-flow meter. A retail device designed for the measurement, at very slow rates (less than 10 gallons per hour), of liquid fuels at individual domestic installations. [3.30]

small-delivery device. Any device other than a large-delivery device. [3.34]

span (structural). The distance between adjoining sections of a scale. [2.20]
(Added 1988)

specification. A requirement usually dealing with the design, construction, or marking of a weighing or measuring device. Specifications are directed primarily to the manufacturers of devices. [1.10]

static monorail weighing system. A weighing system in which the load being applied is stationary during the weighing operation. [2.20]
(Added 1999)

strain-load test. The test of a scale beginning with the scale under load and applying known test weights to determine accuracy over a portion of the weighing range. The scale errors for a strain-load test are the errors observed for the known test loads only. The tolerances to be applied are based on the known test load used for each error that is determined.
[2.20, 2.22]

subordinate graduation. Any graduation other than a main graduation. (Also see "graduation".) [1.10]

subsequent distance or time intervals. The intervals corresponding to money drops following the initial money drop. [5.54]

substitution test. A scale testing process used to quantify the weight of material or objects for use as a known test load.
(Added 2003)

substitution test load. The sum of the combination of field standard test weights and any other applied load used in the conduct of a test using substitution test methods.
(Added 2003)

surface gauge. A combination of (1) a stationary indicator, and (2) a movable, graduated element designed to be brought into contact with the surface of the liquid from above. [4.43]

systematic (average) error $\bar{x}$. The mean value of the error (of indication) for a number of consecutive automatic weighings of a load, or loads, passed over the load-receiving element (e.g., weigh-table), shall be expressed mathematically as: [2.24]

$$\bar{x} = \frac{\sum x}{n}$$

where:

x = error of a load indication
n = the number of loads

(Added 2004)

T

tail pulley. The pulley at the opposite end of the conveyor from the head pulley. [2.21]

take-up. A device to provide sufficient tension in a conveyor belt so that the belt will be positively driven by the drive pulley. A counter-weighted take-up consists of a pulley free to move in either the vertical or horizontal direction with dead weights applied to the pulley shaft to provide the tension required. [2.21]

tare-weighbeam elements. The combination of a tare bar and its fractional bar, or a tare bar alone if no fractional bar is associated with it. [2.20]

tare mechanism. A mechanism (including a tare bar) designed for determining or balancing out the weight of packaging material, containers, vehicles, or other materials that are not intended to be included in net weight determinations. [2.20]

taximeter. A device that automatically calculates, at a predetermined rate or rates, and indicates the charge for hire of a vehicle. [5.54]

testing. An operation consisting of a series of volumetric determinations made to verify the accuracy of the volume chart that was developed by gauging. [4.43]

test chain. A device used for simulated tests consisting of a series of rollers or wheels linked together in such a manner as to assure uniformity of weight and freedom of motion to reduce wear, with consequent loss of weight, to a minimum. [2.21]

test liquid. The liquid used during the test of a device. [3.30]

test object. An object whose dimensions are verified by appropriate reference standards and intended to verify compliance of the device under test with certain metrological requirements. [5.58]
(Added 2004)

test puck. A metal, plastic, or other suitable object that remains stable for the duration of the test, used as a test load to simulate a package. Pucks can be made in a variety of dimensions and have different weights to represent a wide range of package sizes. Metal versions may be covered with rubber cushions to eliminate the possibility of damage to weighing and handling equipment. The puck mass is adjusted to an accuracy specified in N.1.2. Accuracy of Test Pucks or Packages. [2.24]
(Added 2004)

test train. A train consisting of or including reference weight cars and used to test coupled-in-motion railway track scales. The reference weight cars may be placed consecutively or distributed in different places within a train. [2.20]
(Added 1990) (Amended 1991)

test weight car. A railroad car designed to be a stable mass standard to test railway track scales. The test weight car may be one of the following types: a self-contained composite car, a self-propelled car, or a standard rail car. [2.20]
(Added 1991)

time recorder. A clock-operated mechanism designed to record the time of day. Examples of time recorders are those used in parking garages to record the "in" and "out" time of day for parked vehicles. [5.55]

timing device. A device used to measure the time during which a particular paid-for service is dispensed. Examples of timing devices are laundry driers, car-wash timers, parking meters, and parking-garage clocks and recorders. [5.55]

tolerance. A value fixing the limit of allowable error or departure from true performance or value. (See also "basic tolerances".) [1.10]

training idlers. Idlers of special design or mounting intended to shift the belt sideways on the conveyor to assure the belt is centered on the conveying idlers. [2.21]

transfer standard. A measurement system designed for use in proving and testing cryogenic liquid-measuring devices. [3.34]

tripper. A device for unloading a belt conveyor at a point between the loading point and the head pulley. [2.21]

U

uncoupled-in-motion railroad weighing system. A device and related installation characteristics consisting of (1) the associated approach trackage, (2) the scale (i.e., the weighing element, the load-receiving element, and the indicating element with its software), and (3) the exit trackage which permit the weighing of railroad cars uncoupled in motion. [2.20]
(Added 1993)

underregistration. See "overregistration" and "under-registration." [1.10]

unit price. The price at which the product is being sold and expressed in whole units of measurement. [3.30]
(Added 1992)

unit weight. One contained within the housing of an automatic-indicating scale and mechanically applied to and removed from the mechanism. The application of a unit weight will increase the range of automatic indication, normally in increments equal to the reading-face capacity. [2.20]

unit train. A unit train is defined as a number of contiguous cars carrying a single commodity from one consignor to one consignee. The number of cars is determined by agreement among the consignor, consignee, and the operating railroad. [2.20]

user requirement. A requirement dealing with the selection, installation, use, or maintenance of a weighing or measuring device. User requirements are directed primarily to the users of devices. [1.10]

usual and customary. Commonly or ordinarily found in practice or in the normal course of events and in accordance with established practices. [1.10]

V

value of minimum graduated interval. The value represented by the interval from the center of one graduation to the center of the succeeding graduation. Also, the increment between successive recorded values. (Also see "graduated interval".) [1.10]

vehicle on-board weighing system. A weighing system designed as an integral part of or attached to the frame, chassis, lifting mechanism, or bed of a vehicle, trailer, industrial truck, industrial tractor, or forklift truck. [2.20]
(Amended 1993)

vehicle scale. A scale adapted to weighing highway, farm, or other large industrial vehicles (except railroad freight cars), loaded or unloaded. [2.20]

verification scale division, value of (e). A value, expressed in units of weight (mass) and specified by the manufacturer of a device, by which the tolerance values and the accuracy class applicable to the device are determined. The verification scale division is applied to all scales, in particular to ungraduated devices since they have no graduations. The verification scale division, e, may be different from the displayed scale division, d, for certain other devices used for weight classifying or weighing in predetermined amounts, and certain other Class I and II scales. [2.20]

visible type. A type of device in which the measurement takes place in a see-through glass measuring chamber. [3.30]

v_{min} (minimum load cell verification interval). The smallest load cell verification interval, *expressed in units of mass** into which the load cell measuring range can be divided.
[2.20, 2.21, 2.24]
*[*Nonretroactive as of January 1, 2001]*
(Added 1996) (Amended 1999)

W

weighbeam. An element comprising one or more bars, equipped with movable poises or means for applying counterpoise weights or both. [2.20]

weighing element. That portion of a scale that supports the load-receiving element and transmits to the indicating element a signal or force resulting from the load applied to the load-receiving element. [2.20]
(Added 1988)

weigh-labeler. An automatic weighing system that determines the weight of a package and prints a label or other document bearing a weight declaration for each discrete item (usually a label also includes unit and total price declarations). Weigh-labelers are sometimes used to weigh and label standard and random packages (also called "Prepackaging Scales"). [2.24]
(Added 2004)

weighment. A single complete weighing operation.
[2.20, 2.21]
(Added 1986)

weight, unit. See "unit weight." [2.20]

weight classifier. A digital scale that rounds weight values up to the next scale division. These scales usually have a verification scale division, e, that is smaller than the displayed scale division. [2.20]
(Added 1987)

weight ranges. Electrical or electro-mechanical elements incorporated in an automatic indicating scale through the application of which the range of automatic indication of the scale is increased, normally in increments equal to the reading-face capacity. [2.20]

wet basis. See "moisture content (wet basis)." [5.56]

wet hose. A discharge hose intended to be full of product at all times. [See "wet-hose type".] [3.30, 3.31, 3.38]
(Amended 2002)

wet-hose type. A type of device designed to be operated with the discharge hose full of product at all times. [See "wet hose".] [3.30, 3.32, 3.34, 3.37, 3.38]
(Amended 2002)

wheel-load weighers. Compact, self-contained, portable weighing elements specially adapted to determining the wheel loads or axle loads of vehicles on highways for the enforcement of highway weight laws only. [2.20]

wholesale device. Any device other than a retail device. [See "retail device".] [3.30, 3.32]

wing pulley. A pulley made of widely spaced metal bars in order to set up a vibration to shake loose material off the underside (return side) of the belt. [2.21]

Z

zero-load balance. A correct weight indication or representation of zero when there is no load on the load-receiving element. (See also "zero-load balance for an automatic-indicating scale," "zero-load balance for a nonautomatic-indicating scale," "zero-load balance for a recording scale".) [2.20]

zero-load balance, automatic-indicating scale. A condition in which the indicator is at rest at, or oscillates through approximately equal arcs on either side of, the zero graduation. [2.20]

zero-load balance, nonautomatic-indicating scale. A condition in which (a) the weighbeam is at rest at, or oscillates through approximately equal arcs above and below, the center of a trig loop; (b) the weighbeam or lever system is at rest at, or oscillates through approximately equal arcs above and below, a horizontal position or a position midway between limiting stops; or (c) the indicator of a balance indicator is at rest at, or oscillates through approximately equal arcs on either side of, the zero graduation. [2.20]

zero-load balance for a recording scale. A condition in which the scale will record a representation of zero load. [2.20]

zero-load reference (belt-conveyor scales). A zero-load reference value represents no load on a moving conveyor belt. This value can be either; a number representing the electronic load cell output, a percentage of full scale capacity, or other reference value that accurately represents the no load condition of a moving conveyor belt. The no load reference value can only be updated after the completion of a zero load test. [2.21] (Added 2002)

zero-setting mechanism. Means provided to attain a zero balance indication with no load on the load-receiving element. Three types of these mechanisms are: [2.20]

> **manual zero-setting mechanism.** Nonautomatic means provided to attain a zero balance indication by the direct operation of a control. [2.20]
>
> **semiautomatic zero-setting mechanism.** Automatic means provided to attain a direct zero balance indication requiring a single initiation by an operator. [2.20]
>
> **automatic zero-setting mechanism.** Automatic means provided to maintain zero balance indication without the intervention of an operator. [2.20]

zero-setting mechanism (belt-conveyor scale). A mechanism enabling zero totalization to be obtained over a whole number of belt revolutions. [2.21, 2.23] (Added 2002)

zone of uncertainty. The zone between adjacent increments on a digital device in which the value of either of the adjacent increments may be displayed. [2.20]

[THIS PAGE LEFT INTENTIONALLY BLANK]

Appendix A

Fundamental Considerations Associated with the Enforcement of Handbook 44 Codes

1. Uniformity of Requirements

1.1. National Conference Codes. - Weights and measures jurisdictions are urged to promulgate and adhere to the National Conference codes, to the end that uniform requirements may be in force throughout the country. This action is recommended even though a particular jurisdiction does not wholly agree with every detail of the National Conference codes. Uniformity of specifications and tolerances is an important factor in the manufacture of commercial equipment. Deviations from standard designs to meet the special demands of individual weights and measures jurisdictions are expensive, and any increase in costs of manufacture is, of course, passed on to the purchaser of equipment. On the other hand, if designs can be standardized by the manufacturer to conform to a single set of technical requirements, production costs can be kept down, to the ultimate advantage of the general public. Moreover, it seems entirely logical that equipment that is suitable for commercial use in the "specification" States should be equally suitable for such use in other States.

Another consideration supporting the recommendation for uniformity of requirements among weights and measures jurisdictions is the cumulative and regenerative effect of the widespread enforcement of a single standard of design and performance. The enforcement effort in each jurisdiction can then reinforce the enforcement effort in all other jurisdictions. More effective regulatory control can be realized with less individual effort under a system of uniform requirements than under a system in which even minor deviations from standard practice are introduced by independent State action.

Since the National Conference codes represent the majority opinion of a large and representative group of experienced regulatory officials, and since these codes are recognized by equipment manufacturers as their basic guide in the design and construction of commercial weighing and measuring equipment, the acceptance and promulgation of these codes by each State are strongly recommended.

1.2. Form of Promulgation. - A convenient and very effective form of promulgation already successfully used in a considerable number of States is promulgation by citation of National Institute of Standards and Technology Handbook 44. It is especially helpful when the citation is so made that, as amendments are adopted from time to time by the National Conference on Weights and Measures, these automatically go into effect in the State regulatory authority. For example, the following form of promulgation has been used successfully and is recommended for consideration:

> The specifications, tolerances, and other technical requirements for weighing and measuring devices as recommended by the National Conference on Weights and Measures and published in the National Institute of Standards and Technology Handbook 44, Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices, and supplements thereto or revisions thereof, shall apply to commercial weighing and measuring devices in the State.

In some States it is preferred to base technical requirements upon specific action of the State legislature rather than upon an act of promulgation by a State officer. The advantages cited above may be obtained and may yet be surrounded by adequate safeguards to insure proper freedom of action by the State enforcing officer if the legislature adopts the National Conference requirements by language somewhat as follows:

> The specifications, tolerances, and other technical requirements for weighing and measuring devices as recommended by the National Conference on Weights and Measures shall be the specifications, tolerances, and other technical requirements for weighing and measuring devices of the State except insofar as specifically modified, amended, or rejected by a regulation issued by the State (insert title of enforcing officer).

2. Tolerances for Commercial Equipment

2.1. Acceptance and Maintenance Tolerances. - The official tolerances prescribed by a weights and measures jurisdiction for commercial equipment are the limits of inaccuracy officially permissible within that jurisdiction. It is recognized that errorless value or performance of mechanical equipment is unattainable. Tolerances are established, therefore, to fix the range of inaccuracy within which equipment will be officially approved for commercial use. In the case of classes of equipment on which the magnitude of the errors of value or performance may be expected to change as a result of use, two sets of tolerances are established: acceptance tolerances and maintenance tolerances.

Acceptance tolerances are applied to new or newly reconditioned or adjusted equipment, and are smaller than (usually one-half of) the maintenance tolerances. Maintenance tolerances thus provide an additional range of inaccuracy within which equipment will be approved on subsequent tests, permitting a limited amount of deterioration before the equipment will be officially rejected for inaccuracy and before reconditioning or adjustment will be required. In effect, there is assured a reasonable period of use for equipment after it is placed in service before reconditioning will be officially required. The foregoing comments do not apply, of course, when only a single set of tolerance values is established, as is the case with equipment such as glass milk bottles and graduates, which maintain their original accuracy regardless of use, and measure-containers, which are used only once.

2.2. Theory of Tolerances. - Tolerance values are so fixed that the permissible errors are sufficiently small that there is no serious injury to either the buyer or the seller of commodities, yet not so small as to make manufacturing or maintenance costs of equipment disproportionately high. Obviously, the manufacturer must know what tolerances his equipment is required to meet, so that he can manufacture economically. His equipment must be good enough to satisfy commercial needs, but should not be subject to such stringent tolerance values as to make it unreasonably costly, complicated, or delicate.

2.3. Tolerances and Adjustments. - Tolerances are primarily accuracy criteria for use by the regulatory official. However, when equipment is being adjusted for accuracy, either initially or following repair or official rejection, the objective should be to adjust as closely as practicable to zero error. Equipment owners should not take advantage of tolerances by deliberately adjusting their equipment to have a value, or to give performance, at or close to the tolerance limit. Nor should the repair or service personnel bring equipment merely within tolerance range when it is possible to adjust closer to zero error.[1]

3. Testing Apparatus

3.1. Adequacy. - Tests can be made properly only if, among other things, adequate testing apparatus is available. Testing apparatus may be considered adequate only when it is properly designed for its intended use, when it is so constructed that it will retain its characteristics for a reasonable period under conditions of normal use, when it is available in denominations appropriate for a proper determination of the value or performance of the commercial equipment under test, and when it is accurately calibrated.

3.2. Tolerances for Standards.[2] - The error in a standard used by a weights and measures official should be known and corrected for when the standard is used; or if the standard is to be used without correction, its error should be not greater than one-third of the smallest tolerance to be applied when the standard is used. The reason for this is to keep at a minimum the proportion of the tolerance on the item tested that will be used up by the error of the standard. Expressed differently, the reason is to give the item being tested as nearly as practicable the full benefit of its own tolerance.

Field testing operations are complicated to some degree when corrections to standards are applied. Except for work of relatively high precision, it is recommended that the accuracy of standards used in testing commercial weighing and measuring equipment be so established and maintained that the use of corrections is not necessary. Also, whenever it can readily be done, it will be desirable to reduce the error on a standard below the one-third point previously mentioned.

3.3. Accuracy of Standards. - Prior to the official use of testing apparatus, its accuracy should invariably be verified. Standards should be reverified as often as circumstances require. By their nature, metal volumetric standards are more susceptible to damage in handling than are standards of some other types. A standard should be recalibrated whenever damage is known or suspected to have occurred or significant repairs have been made. In addition, standards, particularly volumetric standards, should be recalibrated with sufficient frequency to affirm their continued accuracy, so that the official may always be in an unassailable position with respect to the accuracy of his testing apparatus. Secondary standards, such as special fabric testing tapes, should be verified much more frequently than such basic standards as steel tapes or volumetric provers to demonstrate their constancy of value or performance.

Accurate and dependable results cannot be obtained with faulty or inadequate standards. If either the service person or official is poorly equipped, their results cannot be expected to check consistently. Disagreements can be avoided and the servicing of commercial equipment can be expedited and improved if service persons and officials give equal attention to the adequacy and maintenance of their testing apparatus.

---

[1] See General Code, Section 1.10; User Requirement G-UR.4.3.

[2] The numerical values of the tolerances recommended by the National Institute of Standards and Technology, for the standards of length, mass, and capacity used by weights and measures officials, may be obtained upon request from the Weights and Measures Division of the National Institute of Standards and Technology.

Chapter 6. Automotive Products Specifications

Article 1. Brake Fluid Standards

4100. Specifications. - Brake fluid shall conform to the current specifications of the National Highway Traffic Safety Administration, United States Department of Transportation.

NOTE: Authority cited: Sections 12027 and 13710(c), Business and Professions Code. Reference: Section 13710(c), Business and Professions Code.

Article 2. Brake Fluid Labeling

.

4110 – 4111. - Repealed 11-19-85.

4112. Container Labeling. - In addition to the requirements of Section 13711(d), Business and Professions Code, the label of each container of brake fluid shall bear the brand name in letters not less than one-eighth inch (3.18 mm) in height.

Numerals used in connection with the brand name or merits of the product shall not exceed the actual dry equilibrium reflux boiling point of the product. Nothing in this section prohibits the use of any numeral or combination thereof in such a manner that it cannot reasonably be confused with the dry equilibrium reflux boiling point of the product.

NOTE: Authority cited: Sections 12027, 12609 and 13710(c), Business and Professions Code. Reference: Sections 12602 and 13711(d), Business and Professions Code.

Article 3. Automatic Transmission Fluid Standards

4120 - 4126. - Repealed 8-18-87.

Article 4. Automatic Transmission Fluid Registration

4130. - Repealed 11-19-85.

Article 5. Engine Fuel Standards

4140. Specifications-Automotive Spark Ignition Engine Fuel. Automotive spark ignition engine fuel specifications shall conform to the latest standards set forth in the American Society for Testing and Materials D 4814 with the following exception:

Vapor pressure specifications shall not be more than the maximum specified by any California state law. When the maximum Reid Vapor Pressure specification for automotive spark-ignition engine fuel is below that established by D 4814, the Vapor Pressure/Distillation Class AA specification for distillation temperatures may be applied in the manufacture of automotive spark-ignition engine fuel.

NOTE: Authority cited: Sections 12027 and 13440, Business and Professions Code. Reference: Sections 13401(m), 13440 and 13441, Business and Professions Code.

4141. Specifications-Kerosene. - Kerosene shall meet the specifications set forth by the American Society for Testing and Materials (ASTM) in the latest version of Standard Specification for Kerosene D 3699 contained in ASTM publication entitled: Annual Book of ASTM Standards, Section 5, Volume 05:03.

NOTE: Authority cited: Sections 12027, 12609 and 13450, Business and Professions Code. Reference: Sections 13401(c) and 13450, Business and Professions Code.

4142. Specifications-Fuel Oil. - Fuel oil shall meet the specifications set forth by the American Society for Testing and Materials (ASTM) in the latest version of Standard Specification for Fuel Oils D 396 contained in the ASTM publication entitled: Annual Book of ASTM Standards, Section 5, Volume 05:01, except the sulfur content shall not exceed the maximum specified by any California state law.

NOTE: Authority cited: Sections 12027 and 13450, Business and Professions Code. Reference: Sections 13401(1) and 13450, Business and Professions Code.

4143. Specifications-Diesel Fuel. - Diesel fuel shall meet the specifications set forth by the American Society for Testing and Materials (ASTM) in the latest version of Standard Specification for Diesel Fuel Oils D 975 contained in the ASTM publication entitled: Annual Book of ASTM Standards, Section 5, Volume 05:01, except the sulfur content shall not exceed the maximum specified by any California state law.

NOTE: Authority cited: Sections 12027 and 13450, Business and Professions Code. Reference: Sections 13401(j) and 13450, Business and Professions Code.

4144. Specifications – Developmental Fuels.

(a) Sales of developmental engine fuels authorized by the Department are not subject to restrictions imposed upon the sale of non-conforming fuel products as set forth in Business and Professions Code Sections 13441, 13442 and 13451, but the Department's authorization does not create a variance or waiver from any other applicable California statute or regulation.

(b) An applicant for authorization to sell developmental engine fuel must submit the following information to the Department:

(1) a statement of the potential benefit of the fuel to the people of California; and

(2) a description of test conditions associated with the use of the fuel, including control and monitoring practices, and the method of distribution and storage.

(c) Any authorization provided by the Department is subject to the following terms and conditions:

(1) The authorization is limited to a period of two years, with an automatic renewal for an additional two years in the absence of action to revoke the authorization by the Department; and,

(2) Damages caused by sale, delivery, storage, handling and usage of the fuel shall be addressed in accordance with contractual provisions negotiated and agreed upon by the authorization holder and the user; and,

(3) The authorization holder shall report information to the Department as required to monitor the use of the fuel during the process of developing a generally recognized chemical and performance standard through a recognized consensus organization or standards writing organization, such as the American Society for Testing and Materials ("ASTM") or the Society of Automotive Engineers ("SAE"). The Department shall specify the reporting requirements on a case by case basis at the time the authorization is granted.

(d) The Department may take action to revoke the authorization at any time. Revocation of the authorization is effective and final upon receipt of written notification by the authorization holder. The Department may take action to revoke the authorization if the Department finds:

(1) the authorization holder has violated any of the terms and conditions of the authorization; or,

(2) the authorization holder has abandoned efforts to develop a generally recognized chemical and performance standard for the fuel through a recognized consensus organization or standards writing organization.

(3) there is a high probability of equipment harm with the continued use of the developmental fuel or to protect the public safety.

(e) The authorization shall cease to exist upon publication of a generally recognized chemical and performance standard for the fuel.

NOTE: Authority cited: Sections 12027 and 13405, Business and Professions Code. Reference: Sections 13401, 13440-13443, and 13450-13451, Business and Professions Code.

4145. Specifications – E85 Ethanol Fuel. – E85 Ethanol Fuel shall meet the specifications set forth by ASTM International in the latest version of "Standard Specification for Fuel Ethanol (Ed75 – Ed85) for Automotive Spark-Ignition Engines D 5798", contained in the ASTM publication entitled: Annual Book of ASTM Standards, Section 5, Volume 05:03.

NOTE: Authority cited: Sections 12027 and 13440, Business and Professions Code. Reference: Sections 13401(m), 13440 and 13441, Business and Professions Code.

4146. Specifications – M85 Methanol Fuel. – M85 Methanol Fuel shall meet the specifications set forth by ASTM International in the latest version of "Standard Specification for Fuel Methanol (M70 – M85) for Automotive Spark-Ignition Engines D 5797", contained in the ASTM publication entitled: Annual Book of ASTM Standards, Section 5, Volume 05:03.

NOTE: Authority cited: Sections 12027 and 13440, Business and Professions Code. Reference: Sections 13401(m), 13440 and 13441, Business and Professions Code.

4147. Specifications – Biodiesel Blending Stock and Biodiesel Fuel Blends. – Biodiesel Blending Stock and Biodiesel Fuel Blends shall meet the following specifications:

(1) The diesel fuel used for blending shall meet the specifications set forth by ASTM International in the latest version of "Standard Specification for Diesel Fuel Oils D 975", contained in the ASTM publication entitled: Annual Book of ASTM Standards, Sectiofn 5, Volume 05:01.

(2) Biodiesel blending stock shall meet the specifications set forth by ASTM International in the latest version of "Standard Specification for Biodiesel Fuel (B100) Blend Stock for Distillate Fuels D 6751", contained in the ASTM publication entitled: Annual Book of ASTM Standards, Section 5, Volume 05:04.

(3) Any finished biodiesel fuel blend shall meet the specifications set forth by ASTM International in the latest version of "Standard Specification for Diesel Fuel Oils D 975", contained in the ASTM publication entitled: Annual Book of ASTM Standards, Section 5, Volume 05:01.

NOTE: Authority cited: Sections 12027 and 13450, Business and Professions Code. Reference: Sections 13401(i), 13450 and 13441, Business and Professions Code.

4148. Labeling and Price Advertising Sign Requirements for Biodiesel.

(a) Biodiesel blends shall have the words "Biodiesel fuel (BXX)", where XX represents the volume percent biodiesel in the fuel, used to describe the name of the product on all dispensers, advertising signs, and storage tank labels as required in Section 13480 and 13532 of the Business and Professions Code.

(b) Every biodiesel blend dispenser dispensing blends greater than 5 volume percent (B5) of biodiesel shall display on each customer side, as required by Section 13484 of the Business and Professions Code, a sign clearly visible which reads as follows:

"THIS FUEL CONTAINS BIODIESEL. CHECK THE OWNER'S MANUAL OR WITH YOUR ENGINE MANFUACTURER BEFORE USING."

NOTE: Authority cited: Sections 12027 and 13450, Business and Professions Code. Reference: Sections 13480, 13484 and 13582, Business and Professions Code.

[THIS PAGE LEFT INTENTIONALLY BLANK]